भारत हेवी इलेक्ट्रिकल्स लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)

Ref: PSER:SCT:NBN-C2067:8042 Date: 14-07-2020

# NOTICE INVITING TENDER

NOTE: INTENDING BIDDER TO PARTICIPATE MAY DOWNLOAD FROM WEB SITES

Sealed offers in two part bid system are invited from reputed & experienced bidders meeting PRE QUALIFICATION CRITERIA as mentioned in Annexure-1 through E-Procurement Portal https://bhel.abcprocure.com only, for the subject job by the undersigned on the behalf of BHARAT HEAVY ELECTRICALS LIMITED as per the tender document. Issue/ forwarding intimation regarding tender to any bidder shall not construe that the bidder is considered to be qualified. Consideration of their offer is subject to CUSTOMER APPROVAL & compliance of loading criteria as per clause no. 8.0 of NIT etc. specified below. Following points relevant to the tender may please be noted and complied with.

1.0 Salient Features of NIT

| SL NO | ISSUE | DESCRIPTION | |
|---|---|---|---|
| i | TENDER NUMBER | PSER:SCT:NBN-C2067:20. | |
| ii | Broad Scope of job | *Construction of 4 nos 150 M Tall Single Flue RCC Chimney with Borosilicate Glass Block Lining System on MS Flue Can (excluding pile) at 4x250 MW BRBCL Nabinagar TPP FGD, Bihar.* | |
| iii | DETAILS OF TENDER DOCUMENT | | |
| a | Volume-IA | *General conditions of contract (Supply)* | *Not Applicable.* |
| b | Volume-IB | *General conditions of contract (Service)* | *Applicable.* |
| c | Volume-IC | *Special conditions of contract (Supply)* | *Not Applicable.* |
| d | Volume-ID | *Special conditions of contract (Service)* | *Applicable.* |
| e | Volume-IE | *Forms and Procedures etc.* | *Applicable.* |
| f | Volume-IF | *Technical Conditions of Contract (TCC) (CML, TS)* | *Applicable.* |
| g | Volume-III | *Price Schedule (Absolute value) – Rev-00* | *Applicable.* |
| iv | ISSUE OF TENDER DOCUMENTS | *This is an E-tender floated online through our E-Procurement Site https://bhel.abcprocure.com.* *Start date of the tender: 14-07-2020.* | *Applicable.* |
| v | DUE DATE & TIME OF OFFER SUBMISSION | *Date: 04-08-2020, Time: 15-00 Hrs. IST* *The bidder should respond by submitting their offer online in our e-Procurement platform at https://bhel.abcprocure.com only. Offers are invited in two-parts only.* *Hard copy bid or bids through email/fax shall not be accepted.* | *Applicable.* |
| vi | OPENING OF TENDER | *Date: 04-08-2020.* *1 hour after the latest due date and time of Offer submission* *Notes:* *(1) In case the due date of opening of tender becomes a non-working day, tenders shall be opened on next working day at the same time.* *(2) Bidder may depute representative to witness the opening of tender.* | *Applicable.* |

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)
POWER SECTOR EASTERN REGION, DJ-9/1, SALT LAKE CITY, KOLKATA - 700 091
फैक्स/Fax : (033) 23211960 फोन/Phone : बोर्ड/EPABX : 23211691/ 23398000

| | | | |
|---|---|---|---|
| vii | EMD AMOUNT | -- | *Not Applicable.* |
| viii | COST OF TENDER | *Rs. 10,000/-* | *Applicable.* |
| ix | LAST DATE FOR SEEKING CLARIFICATION | *Date: 21-07-2020.*<br>*Along with soft version also, addressing to undersigned & to others as per contact address given below* | *Applicable.* |
| x | SCHEDULE OF Pre Bid Discussion (PBD) | -- | *Not Applicable (In case BHEL decides to conduct PBD, date, time & venue of PBD will be intimated suitably thru TCN.)* |
| xi | INTEGRITY PACT & DETAILS OF INDEPENDENT EXTERNAL MONITOR (IEM) | *IEM DETAILS:*<br><br>*Refer Clause No 34.0 below.* | *Applicable.* |
| xii | Latest updates | Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc to Tender Specifications will be hosted in BHEL webpage (www.bhel.com) ; CPP portal & E-Procurement Site https://bhel.abcprocure.com only. Bidders to keep themselves updated with all such information. | *Shall be intimated to bidder.* |

2.0 The offer shall be submitted as per the instructions of tender document and as detailed in this NIT. Bidders to note specifically that all pages of tender document, including these NIT pages of this particular tender together with subsequent correspondences shall be submitted by them, duly digitally signed & stamped on each page, as part of offer. Rates/Price including discounts/rebates, if any, mentioned anywhere/ in any form in the techno-commercial offer other than the Price Bid, shall not be entertained.

3.0 Unless specifically stated otherwise, bidder shall remit cost of tender (non-refundable) and courier charges if applicable, in the form of Demand Draft drawn in favour of Bharat Heavy Electricals Ltd, payable at Kolkata, issuing the Tender, along with techno-commercial offer.

4.0 Unless specifically stated otherwise, bidder shall have to deposit EMD through Demand Draft/Pay Order in favour of Bharat Heavy Electricals Ltd, payable at Kolkata. For other details please refer General Conditions of Contract.
Bidders may please be noted that "OEMD" provision stands deleted. Hence, bidders who have deposited Rs. 2 Lakh as OEMD are also requested to submit fresh EMD as mentioned in sl no vii under clause no 1.0 of NIT.

5.0 Procedure for Submission of Tenders: The Tenderers must submit their Tenders as detailed below:

**DOCUMENTS TO BE UPLOADED & MODALITY OF UPLOADING**

| Sl no | Description | Remarks |
|---|---|---|
| PART-I A | (TECHNO COMMERCIAL BID) | |
| | CONTAINING THE FOLLOWING:- | |
| i. | Covering letter/Offer forwarding letter of Tenderer. (**To be attached in relevant Attachment section**) | |
| ii. | Duly filled-in `No Deviation Certificate' as per prescribed format. (To be attached in relevant Attachment section) | |

| | | |
|---|---|---|
| | Note:<br>a. In case of any deviation, the same should be submitted separately for technical & commercial parts, indicating respective clauses of tender against which deviation is taken by bidder. The list of such deviation shall be attached in relevant attachment section of the e –procurement portal. It shall be specifically noted that deviation recorded elsewhere shall not be entertained.<br><br>b. BHEL reserves the right to accept/reject the deviations without assigning any reasons, and BHEL decision is final and binding.<br>i). In case of acceptance of the deviations, appropriate loading shall be done by BHEL<br>ii). In case of unacceptable deviations, BHEL reserves the right to reject the tender | |
| iii. | Supporting documents/ annexures / schedules/ drawing etc as required in line with Pre-Qualification criteria.<br><br>It shall be specifically noted that all documents as per above shall be attached in relevant attachment section and credential certificates issued by clients shall distinctly bear the name of organization, contact ph no, FAX no, etc. | |
| iv. | All Amendments/Correspondences/Corrigenda/Clarifications/Changes/ Errata etc pertinent to this NIT.<br>(To be attached in relevant Attachment section) | |
| v. | Integrity Pact Agreement (Duly signed by the authorized signatory) | Applicable |
| vi. | Duly filled-in annexures, formats etc as required under this Tender Specification/NIT<br>(To be attached in relevant Attachment section) | |
| vii. | Notice inviting Tender (NIT)<br>(To be attached in relevant Attachment section) | |
| viii. | Volume – I F: Technical Conditions of Contract (TCC)<br>(To be attached in relevant Attachment section) | |
| ix. | Volume – I D: Special Conditions of Contract (SCC)-Service<br>(To be attached in relevant Attachment section) | |
| x. | Volume – I B: General Conditions of Contract (GCC)-Service<br>(To be attached in relevant Attachment section) | |
| xii. | Volume – I E: Forms & Procedures etc.<br>(To be attached in relevant Attachment section) | |
| xiii. | Volume–III - (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item.<br>(To be attached in Unpriced Bid Attachment section) | |
| xiv. | Any other details preferred by bidder with proper indexing.<br>(To be attached in relevant Attachment section) | |

| | | |
|---|---|---|
| PART-I B | EMD/ COST OF TENDER<br>(To be submitted offline within due date of offer submission) | |
| | CONTAINING THE FOLLOWING:- | |
| i. | 1. Earnest Money Deposit (EMD) in the form as indicated in this Tender<br><br>2. Cost of Tender (Demand Draft or copy of Cash Receipt as the case may be) | |

| | | |
|---|---|---|
| PART-II | PRICE BID<br>(TO BE ATTACHED IN PRICE BID ATTACHMENT SECTION) | |
| | CONTAINING THE FOLLOWING:- | |
| i | Covering letter/Offer forwarding letter of Tenderer enclosed in Part-I | |
| ii | Volume III – PRICE BID (Duly Filled in Schedule of Rates – rate/price to be entered in words as well as figures)<br>Any other document uploaded in the price bid, apart from above tender format, shall not be taken into cognizance for evaluation of offer. | |

SPECIAL NOTE:

A) Your offer & documents submitted along with offer shall be digitally signed & stamped in each page by your authorised representative. No overwriting/ correction in tender documents by bidders shall be allowed. However, if correction is unavoidable, the same may be signed by authorized signatory.
B) The credentials/ documents submitted towards compliance of Pre-qualification requirement shall be physically signed by the authorized signatory & stamped before uploading/submission with the offer in the e-procurement portal.
C) All documents/ annexures submitted with the offer shall be properly attached in the respective sections. BHEL shall not be responsible for any missing documents.

6.0 No Deviation with respect to tender clauses and no additional clauses/ suggestions/ in Techno-commercial bid/ Price bid shall normally be considered by BHEL. Bidders are requested to positively comply with the same.

7.0 BHEL reserves the right to accept or reject any or all Offers without assigning any reasons thereof. BHEL also reserves the right to cancel the Tender wholly or partly without assigning any reason thereof. Also BHEL shall not entertain any correspondence from bidders in this matter (except for the refund of EMD).

8.0 Assessment of Capacity of Bidders:

Bidder's capacity for executing the job under tender shall be assessed 'LOAD' wise and 'PERFORMANCE' wise as per the following:

I. LOAD: Load takes into consideration ALL the contracts of the Bidder under execution with BHEL Regions, irrespective of whether they are similar to the tendered scope or not. The cut off month for reckoning 'Load' shall be the 3rd Month preceding the month corresponding to the 'latest date of bid submission', in the following manner -
(Note: For example, if latest bid submission is in Jan 2017, then the 'load' shall be calculated up to and inclusive of Oct 2016)

Total number of Packages in hand = Load (P)

Where 'P' is the sum of all unit wise identified packages (refer table-1) under execution with BHEL Regions as on the cut off month defined above, including packages yet to be commenced, excepting packages which are on Long Hold.

II. PERFORMANCE: Here 'Monthly Performance' of the bidder for all the packages (under execution/ executed during the 'Period of Assessment' in all Power Sector Regions of BHEL) SIMILAR to the packages covered under the tendered scope, excepting packages not commenced shall be taken into consideration. The 'Period of Assessment' shall be 6 months preceding and including the cut off month. The cut off month for reckoning 'Period of Assessment' shall be the 3rd Month preceding the month corresponding to 'latest date of bid submission', in the following manner:

(Note: For example, if 'latest date of bid submission' is in Jan 2017, then the 'performance' shall be assessed for a 6 months' period up to and inclusive of Oct 2016 (i.e. from May 2016 to Oct 2016), for all the unit wise identified packages (refer Table I))

i). Calculation of Overall 'Performance Rating' for 'Similar Package/Packages' for the tendered scope under execution at Power Sector Regions for the 'Period of Assessment':

This shall be obtained by summing up the 'Monthly Performance Evaluation' scores obtained by the bidder in all Regions for all the similar Package/packages', divided by the total number of Package months for which evaluation should have been done, as per procedure below:

a) $P_1$, $P_2$, $P_3$, $P_4$, $P_5$ , …. $P_N$ etc. be the packages (under execution/ executed during the 'Period of Assessment' in all Regions of BHEL) SIMILAR to the packages covered under the tendered scope, excepting packages not commenced. Total number of similar packages for all Regions = $P_T$ (i.e. $P_T = P_1 + P_2 + P_3 + P_4 + \ldots P_N$)

b) Number of Months '$T_1$' for which 'Monthly Performance Evaluation' as per relevant formats, should have been done in the 'Period of Assessment' for the corresponding similar package $P_1$. Similarly $T_2$ for package $P_2$,$T_3$ for package $P_3$, etc. for the tendered scope. Now calculate cumulative total months '$T_T$' for total similar Packages '$P_T$' for all Regions (i.e. $T_T = T_1 + T_2 + T_3 + T_4 + ..T_N$ )

c) Sum '$S_1$ 'of 'Monthly Performance Evaluation' Scores ($S_{1\text{-}1}$, $S_{1\text{-}2}$, $S_{1\text{-}3}$, $S_{1\text{-}4}$, $S_{1\text{-}5}$…. $S_{1\text{-}T1}$) for similar package $P_1$, for the 'period of assessment' '$T_1$' (i.e. $S_1 = S_{1\text{-}1} + S_{1\text{-}2} + S_{1\text{-}3} + S_{1\text{-}4} + S_{1\text{-}5} + \ldots S_{1\text{-}T1}$). Similarly, $S_2$ for package $P_2$ for period $T_2$, $S_3$ for package $P_3$ for period $T_3$ etc. for the tendered scope for all Regions. Now calculate cumulative sum '$S_T$' of 'Monthly Performance Evaluation' Scores for total similar Packages '$P_T$' for all Regions (i.e. '$S_T$ '$= S_1 + S_2 + S_3 + S_4 + S_5 + \ldots S_N$.)

d) Overall Performance Rating '$R_{BHEL}$' for the Similar Package/Packages (under execution/ executed during the 'Period of Assessment') in all the Power Sector Regions of BHEL

$$= \frac{\text{Aggregate of Performance scores for all similar packages in all the Regions}}{\text{Aggregate of months for each of the similar packages for which performance should have been evaluated in all the Regions}}$$

$$= \frac{S_T}{T_T}$$

e) Bidders to note that the risk of non-evaluation or non-availability of the 'Monthly Performance Evaluation' reports as per relevant formats is to be borne by the Bidder.

f) Table showing methodology for calculating 'a', 'b' and 'c' above

| Sl. No. | Item Description | Details for all Regions | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| (i) | (ii) | (iii) | (iv) | (v) | (vi) | (vii) | (viii) | (ix) | (x) |
| 1 | Similar Packages for all Regions → (under execution/ executed during period of assessment) | $P_1$ | $P_2$ | $P_3$ | $P_4$ | $P_5$ | … | $P_N$ | Total No. of similar packages for all Regions = $P_T$ i.e. Sum (Σ) of columns (iii) to (ix) |

| Sl. No. | Item Description | Details for all Regions | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| (i) | (ii) | (iii) | (iv) | (v) | (vi) | (vii) | (viii) | (ix) | (x) |
| 2 | Number of Months for which 'Monthly Performance Evaluation' as per relevant formats should have been done in the 'period of assessment' for corresponding Similar Packages ( as in row 1) | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | … | $T_N$ | Sum (Σ) of columns (iii) to (ix) = $T_T$ |
| 3 | Monthly performance scores for the corresponding period (as in Row 2) | $S_{1-1}$, $S_{1-2}$, $S_{1-3}$, $S_{1-4}$, … $S_{1-T1}$ | $S_{2-1}$, $S_{2-2}$, $S_{2-3}$, $S_{2-4}$, … $S_{2-T2}$ | $S_{3-1}$, $S_{3-2}$, $S_{3-3}$, $S_{3-4}$, … $S_{3-T3}$ | $S_{4-1}$, $S_{4-2}$, $S_{4-3}$, $S_{4-4}$, … $S_{4-T4}$ | $S_{5-1}$, $S_{5-2}$, $S_{5-3}$, $S_{5-4}$, … $S_{5-T5}$ | .. … … … … | $S_{N-1}$, $S_{N-2}$, $S_{N-3}$, $S_{N-4}$, … $S_{N-TN}$ | -------- |
| 4 | Sum of Monthly Performance scores of the corresponding Package for the corresponding period (as in row-3) | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | … | $S_N$ | Sum (Σ) of columns (iii) to (ix) = $S_T$ |

ii). Calculation of Overall 'Performance Rating' ($R_{BHEL}$) in case at least 6 evaluation scores for 'similar Package/Packages' for the tendered scope ARE NOT AVAILABLE, during the 'Period of Assessment':

This shall be obtained by summing up the 'Monthly Performance Evaluation' scores obtained by the bidder in all Regions for ALL the packages, divided by the total number of Package months for which evaluation should have been done. '$R_{BHEL}$' shall be calculated subject to availability of 'performance scores' for at least 6 'package months' in the order of precedence below:

a) 'Period of Assessment' i.e. 6 months preceding and including the cut-off month
b) 12 months preceding and including the cut-off month
c) 24 months preceding and including the cut-off month

In case, $R_{BHEL}$ cannot be calculated as above, then Bidder shall be treated as 'NEW VENDOR'. Further eligibility and qualification of this bidder shall be as per definition of 'NEW VENDOR' described in 'Explanatory Notes'.

iii). Factor "L" assigned based on Overall Performance Rating ($R_{BHEL}$) at Power Sector Regions:

| Sl. no. | Overall Performance Rating ($R_{BHEL}$) | Corresponding value of 'L' |
|---|---|---|
| 1 | =60 | NA |
| 2 | > 60 and ≤ 65 | 0.4 |
| 3 | > 65 and ≤ 70 | 0.35 |
| 4 | > 70 and ≤ 75 | 0.25 |
| 5 | > 75 and < 80 | 0.2 |
| 6 | ≥ 80 | NA |

III. 'Assessment of Capacity of Bidder':

'Assessment of Capacity of Bidder' is based on the Maximum number of packages for which a vendor is eligible, considering the performance scores of similar packages, as below:

Max number of packages $P_{Max}$= ($R_{BHEL}$ - 60) divided by corresponding value of 'L', i.e. ($R_{BHEL}$- 60)/L

Note:

i). In case the value of $P_{Max}$ results in a fraction, the value of $P_{Max}$ is to be rounded off to next whole number

ii). For $R_{BHEL}$ = 60, $P_{Max}$ = '1'

iii). For $R_{BHEL} \geq 80$, there will be no upper limit on $P_{Max}$

The Bidder shall be considered 'Qualified' as per 'Assessment of Capacity of Bidder' for the subject Tender if $P \leq P_{Max}$

(Where P is calculated as per clause 'I' above)

Note: For the transition period of 1 year (i.e. for all the NITs floated between 11th May 2019 to 10th May 2020), in addition to above, 'Assessment of Capacity of Bidder' shall also be calculated considering 'performance scores' till 36 months as per Sl. no II ii).

Higher of the results obtained out of both shall be considered for 'Assessment of Capacity of Bidder'.

IV. Explanatory note:

i). Similar package means Boiler or ESP or Piping or Turbine or Civil or Structure or Electrical or C&I etc. at the individual level irrespective of rating of Plant and irrespective of whether the subject tender is a single package or as part of combined/composite packages. Normally Boiler, ESP, Piping, Turbine, Electrical, C&I, Civil, Structure etc. is considered individual level of package. For example, in case the tendered scope is a Boiler Vertical Package comprising of Boiler, ESP and Power Cycle Piping (i.e. the 'identified packages as per Table-1 below), the 'PERFORMANCE' part against sl.no. II above, needs to be evaluated considering all the identified packages (i.e. Boiler, ESP and Power Cycle Piping) and finally the Bidder's capacity to execute the tendered scope is assessed in line with III above.

ii). Identified Packages (Unit wise)

Table-1

| Civil | Electrical and C&I | Mechanical |
|---|---|---|
| i). Enabling works<br>ii). Pile and Pile Caps<br>iii). Civil Works including foundations<br>iv). Structural Steel Fabrication & Erection<br>v). Chimney<br>vi). Cooling Tower<br>vii). Others (Civil) | i). Electrical<br>ii). C&I<br>iii). Others (Elect. and C&I) | i). Boiler & Aux (All types including CW Piping if applicable)<br>ii). Power Cycle Piping/Critical Piping<br>iii). ESP<br>iv). LP Piping<br>v). Steam Turbine Generator set & Aux<br>vi). Gas Turbine Generator set & Aux<br>vii). Hydro Turbine Generator set & Aux<br>viii). Turbo Blower (including Steam Turbine)<br>ix). Material Management<br>x). Others (Mechanical) |

iii). Bidders who have not been evaluated for at least six package months in the last 24 months preceding and including the Cut-off month in the online BHEL system for contractor performance evaluation in BHEL PS Regions, shall be considered "NEW VENDOR".

A 'NEW VENDOR' shall be considered qualified subject to satisfying all other tender conditions.

A 'NEW VENDOR' if awarded a job (of package/packages identified under this clause) shall be tagged as "FIRST TIMER" on the date of first LOI from BHEL.

The "FIRST TIMER" tag shall remain till completion of all the contracts against which vendor has been tagged as First Timer or availability of 6 evaluation scores within last 24 months preceding and including the Cut-off month in the online BHEL system for contractor performance evaluation in BHEL PS Regions.

A Bidder shall not be eligible for the next job as long as the Bidder is tagged as "FIRST TIMER" excepting for the Tenders which have been opened on or before the date of the bidder being tagged as 'FIRST TIMER'.

After removal of 'FIRST TIMER' tag, the Bidder shall be considered 'QUALIFIED' for the future tenders subject to satisfying all other tender conditions including 'Assessment of Capacity of Bidders'.

iv). Consequent upon applying the criteria of 'Assessment of Capacity of Bidders' detailed above on all the bidders qualified against Technical and Financial Qualification criteria, if the number of qualified bidders reduces to less than four, then for further processing of the Tender, BHEL at its discretion reserves the right to also consider the bidders who are "not qualified" as per criteria of 'Assessment of Capacity of Bidders' and for this, procedure described in following three options shall be followed:

a) All the bidders having Overall Performance Rating ('$R_{BHEL}$') ≥60 shall be considered qualified against criteria of 'Assessment of Capacity of Bidders'.
b) If even after using option "a", the number of qualified bidders remains less than four, then in addition to bidders considered as per option "a", "First timer" bidders having average of available performance scores ≥60 upto and including the Cut Off month shall also be considered qualified against criteria of 'Assessment of Capacity of Bidders'.
c) If even after using option "a" and "b", the number of qualified bidders remains less than four, then in addition to bidders considered as per option "a" and "b", "First timer" bidders for whom no performance score is available in the system upto and including the Cut Off month, shall also be considered qualified against criteria of 'Assessment of Capacity of Bidders'.

Note:- In case, the number of bidders qualified against Technical and Financial Qualification criteria itself is less than four, then all bidders (a)- having Overall Performance Rating ('$R_{BHEL}$') ≥60, (b)- First timer" bidders having average of available performance scores ≥60 upto and including the Cut Off month, (c)- "First timer" bidders for whom no performance score is available in the system upto and including the Cut Off month, shall be considered qualified against criteria of 'Assessment of Capacity of Bidders' for further processing of tender.

v). 'Under execution' shall mean works in progress as per the following:

a. Up to execution of 90% of anticipated Contract Value in case of Civil, MM, Structural and Turbo Blower Packages
b. Up to Steam Blowing in case of Boiler/ESP/Piping Packages
c. Up to Synchronization in all Balance Packages

Note: BHEL at its discretion can extend (or reduce in exceptional cases in line with Contract conditions) the period defined against (a), (b) and (c) above, depending upon the balance scope of work to be completed.

vi). Contractor shall provide the latest contact details i.e. mail-ID and Correspondence Address to SCT Department, so that same can be entered in the Contractor Performance Evaluation System, and in case of any change/discrepancy same shall be informed immediately. Login Details for viewing scores in Contractor Performance Evaluation System shall be provided to the Contractor by SCT Department.

vii). Performance Evaluation for Activity Month shall be completed in Evaluation Month (i.e. month next to Activity Month) or in rare cases in Post Evaluation Month (i.e. month next to Evaluation Month) after approval from Competent Authority. In case scores are not acceptable, Contractor can submit Review Request to GM Site/ GM Project latest by 25th of Evaluation Month or 3 days after approval of score, whichever is later. However, acceptance/rejection of 'Review Request' solely depends on the discretion

of GM Site/GM Project. After acceptance of Review Request, evaluation score shall be reviewed at site and the score after completion of review process shall be acceptable and binding on the contractor.

viii). Project on Hold due to reasons not attributable to bidder -

a. Short hold: Evaluation shall not be applicable for this period, however Loading will be considered.

b. Long hold: Short hold for continuous six months and beyond or hold on account of Force Majeure shall be considered as Long Hold. Evaluation as well as Loading shall not be considered for this period.

ix). Performance evaluation in CL 8 above is applicable to Prime bidder and Consortium partner (or Technical tie up partner) for their respective scope of work.

9.0 Since the job shall be executed at site, bidders must visit site/ work area and study the job content, facilities available, availability of materials, prevailing site conditions including law & order situation, applicable wage structure, wage rules, etc before quoting for this tender. They may also consult this office before submitting their offers, for any clarifications regarding scope of work, facilities available at sites or on terms and conditions.

10.0 For any clarification on the tender document, the bidder may seek the same in writing, through e-mail or through E-Procurement Site https://bhel.abcprocure.com, as per specified format, within the scheduled date for seeking clarification, from the office of the undersigned. BHEL shall not be responsible for receipt of queries after due date of seeking clarification due to any delay. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.

11.0 BHEL may decide holding of pre-bid discussion [PBD] with all intending bidders as per date indicated in the NIT. The bidder shall ensure participation for the same at the appointed time, date and place as may be decided by BHEL. Bidders shall plan their visit accordingly. The outcome of pre-bid discussion (PBD) shall also form part of tender.

12.0 In the event of any conflict between requirement of any clause of this specification/ documents/drawings/data sheets etc or requirements of different codes/standards specified, the same to be brought to the knowledge of BHEL in writing for clarification before due date of seeking clarification (whichever is applicable), otherwise, interpretation by BHEL shall prevail. Any typing error/missing pages/ other clerical errors in the tender documents, noticed must be pointed out before pre-bid meeting/submission of offer else BHEL's interpretation shall prevail.

13.0 Unless specifically mentioned otherwise, bidder's quoted price shall deemed to be in compliance with tender including PBD.

14.0 Bidders shall submit Integrity Pact Agreement (Duly signed by authorized signatory who signs in the offer), along with techno - commercial bid. This pact shall be considered as a preliminary qualification for further participation. The names and other details of Independent External Monitor (IEM) for the subject tender is as given at point (xi) of 1 above.

15.0 The Bidder has to satisfy the Pre Qualifying Requirements stipulated for this Tender in order to be qualified. The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of satisfying the Pre Qualification Criteria specified in this NIT as per Annexure-1 (as applicable), past performance etc. and date of opening of price bids shall be intimated to only such bidders. BHEL reserves the right not to consider offers of parties under HOLD.

16.0 In case BHEL decides on a `Public Opening', the date & time of opening of the PRICE BID shall be intimated to the qualified bidders and in such as case, price bid (Volume-III) uploaded in E-procurement Site https://bhel.abcprocure.com will be opened.

17.0 Validity of the offer shall be for six months from the latest due date of offer submission (including extension, if any) unless specified otherwise.

18.0 BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on www.bhel.com) for this tender. RA shall be conducted among all the techno-commercially qualified bidders.

Price bids of all techno-commercially qualified bidders shall be opened and same shall be considered as initial bids of bidders in RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking.

19.0 On submission of offer, further consideration will be subject to compliance to tender & qualifying requirement and customer's acceptance, as applicable.

20.0 In case the bidder is an "Indian Agent of Foreign Principals", 'Agency agreement has to be submitted along with Bid, detailing the role of the agent along with the terms of payment for agency commission in INR, along with supporting documents.

21.0 The bidders shall not enter into any undisclosed M.O.U. or any understanding amongst themselves with respect to tender.

22.0 Consortium Bidding (or Technical Tie up) shall be allowed only if specified in Pre Qualifying Requirement (PQR) criteria, and in such a case the details to be complied with is enclosed herewith as per Annexure-5 UNLESS SPECIFIED OTHERWISE IN PQR.

23.0 The bidder shall submit documents in support of possession of 'Qualifying Requirements' duly self certified and stamped/ digitally signed (as applicable) by the authorized signatory, indexed and properly linked in the format for PQR. In case BHEL requires any other documents/proofs, these shall be submitted immediately.

24.0 The bidder may have to produce original document for verification if so decided by BHEL.

25.0 The offers of the bidders who are on the banned list as also the offer of the bidders, who engage the services of the banned firms, shall be rejected. The list of banned firms is available on BHEL Website (www.bhel.com).

I) Integrity commitment, performance of the contract and punitive action thereof:

a) Commitment by BHEL:

BHEL commits to take all measures necessary to prevent corruption in connection with the tender process and execution of the contract. BHEL will during the tender process treat all Bidder(s) in a transparent and fair manner, and with equity.

b) Commitment by Bidder/ Supplier/ Contractor:

b.i) The bidder/ supplier/ contractor commit to take all measures to prevent corruption and will not directly or indirectly influence any decision or benefit which he is not legally entitled to nor will act or omit in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India.

b.ii) The bidder/ supplier/ contractor will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract and shall adhere to relevant guidelines issued from time to time by Govt. of India/ BHEL.

b.iii) The bidder/ supplier/ contractor will perform/ execute the contract as per the contract terms & conditions and will not default without any reasonable cause, which causes loss of business/ money/ reputation, to BHEL.

If any bidder/ supplier/ contractor during pre-tendering/ tendering/ post tendering/ award/ execution/ post-execution stage includes in mal-practices, cheating, bribery, fraud or and other misconduct or formation of cartel so as to influence the bidding process or influence the price or acts or omits in any manner which tantamount to an offence punishable under any provision of the Indian Penal code, 1860 or any other law in force in India, then, action may be taken against such bidder/ supplier/ contractor as per extant guidelines of the company available on www.bhel.com and/ or under applicable legal provisions.

26.0 It may please be noted that Guidelines/Rules in respect of Suspension of business dealings (Hold- 12 to 24 Months/ Banning – 3 years etc), Vendor Evaluation formats, quality, safety and HSE guidelines, standard T&P hire charges of BHEL etc may undergo change from time to time and the latest one shall be followed. Latest "Guidelines for Vendor Evaluation" is web based, quality, safety & HSE"; standard T&P hire charges shall be available at site and shall be given to the successful vendors/ subcontractors during execution.

27.0 MSE suppliers can avail the intended benefits in respect of the procurements related to the Goods and Services only (Definition of Goods and Services as enumerated by Govt. of India vide Office Memorandum F. No. 21(8)/2011-MA dtd. 09/11/2016 office of AS & DC, MSME) if they submit along with the offer, attested copies of either Udyam Registration Certificate or EM II certificate having deemed validity (five years from the date of issue of acknowledgement in EM II) or valid NSIC certificate or Udyog Aadhar Memorandum (UAM) & Acknowledgement or EM II certificate along with attested copy of a CA certificate (Format enclosed at Annexure – C where deemed validity of EM II certificate of five years has expired) applicable for the relevant financial year (latest audited). Date to be reckoned for determining the deemed validity will be the date of bid opening (Part 1 in case of two part bid). Non submission of such documents will lead to consideration of their bid at par with other bidders. No benefit shall be applicable for this enquiry if any deficiency in the above required documents are not submitted before price bid opening. If the tender is to be submitted through e-procurement portal, then the above required documents are to be uploaded on the portal. Documents should be notarized or attested by a Gazetted officer.

Any Bidder falling under MSME category, shall furnish the following details & submit documentary evidence/Govt. Certificate etc. in support of the same along with their techno-commercial offer: -

| Type under MSME | SC/ST owned | Women owned | Others |
|---|---|---|---|
| Micro | | | |
| Small | | | |
| Medium | | | |

Note: - If the bidder does not furnish the above, offer shall be processed construing that the bidder is not falling under MSME category.

28.0 The bidder along with its associates/collaborators/sub-contractors/sub-vendors/consultants/service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website www.bhel.com and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice.

29.0 Annexure-A -Amendment to GCC/SCC shall be read in conjunction with GCC-Volume-IB & SCC-Volume-ID. This Annexure-A (Amendment to GCC/SCC) of NIT shall not be considered as part of the NIT but addendum/corrigendum to the GCC/SCC only.

30.0 Annexure-B - Terms & conditions of Reverse Auction is enclosed herewith.

31.0 Annexure-D – Specific Clause w.r.t. BOCW Act & Cess Act is enclosed herewith.

32.0 Annexure-E- Statewise GST Registration nos. is enclosed herewith.

33.0 Duly filled & signed Annexure- CPP-GST/I to be submitted by bidders along with their techno-commercial offer.

34.0 Integrity Pact (IP) –

(a) IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. Following Independent External Monitors (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.

| Sl | IEM | Email |
|---|---|---|
| 1. | Shri Arun Chandra Verma, IPS (Retd.) | acverma1@gmail.com |
| 2. | Shri Virendra Bahadur Singh, IPS (Retd.) | vbsinghips@gmail.com |

(b) The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory) along with techno-commercial bid (Part-I, in case of two/three part bid). Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification.

(c) Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEM(s). All correspondence with the IEMs shall be done through email only.

Note:

No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department's officials whose contact details are provided below:

Details of contact person(s):

| Name | Anupriya Mundu/Malini Mandal | Subrata Sen |
|---|---|---|
| Dept | SCT Dept, BHEL PSER, Kolkata | SCT Dept, BHEL PSER, Kolkata |
| Address | DJ-9/1, Sector – II, Salt Lake, Kolkata – 700091 | DJ-9/1, Sector – II, Salt Lake, Kolkata – 700091 |
| Phone | 033-2339 8236/ 8231 | 033-2339 8226 |
| Email | anupriya.mundu@bhel.in/malini@bhel.in | subrata.sen@bhel.in |
| FAX | 033-2321 1960 | 033-2321 1960 |

35.0 For this procurement, Public Procurement (Preference to Make in India), Order 2017 dated 15.06.2017, 28.05.2018, 29-05-2019 & 04-06-2020 and subsequent Orders issued by the respective Nodal Ministry shall be applicable even if issued after issue of this NIT but before finalization of contract/ PO/ WO against this NIT.
In the event of any Nodal Ministry prescribing higher or lower percentage of purchase preference and/ or local content in respect of this procurement, same shall be applicable.

Duly filled & signed Form-2 (Format for local content), as applicable, to be submitted by bidders along with their techno-commercial offer.

36.0 Bidders are requested to submit their best price as per latest price schedule of the tender.

37.0 It may please be noted that Bid should be free from correction, overwriting, using corrective fluid, etc. Any interlineation, cutting, erasure or overwriting shall be valid only if they are attested under full signature(s) of person(s) signing the bid, else bid shall be liable for rejection.
All overwriting/ cutting, etc will be numbered by bid opening officials and announced during bid opening.

38.0 The contractor shall, at all stages of work deploy skilled/ semi-skilled tradesmen who are qualified and

possess certificate in particular trade from CPWD Training Institute/ Industrial Training Institute/National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/certified by State/ Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/ semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

39.0 Order of Precedence

In the event of any ambiguity or conflict between the Tender Documents, the order of precedence shall be in the order below:

a. Amendments/Clarifications/Corrigenda/Errata etc issued in respect of the tender documents by BHEL
b. Notice Inviting Tender (NIT)
c. Price Bid-Volume-III
d. Technical Conditions of Contract (TCC) -- Volume-IF
e. Special Conditions of Contract (SCC) —Volume-ID
f. General Conditions of Contract (GCC) —Volume-IB
g. Forms and Procedures —Volume-IE

for BHARAT HEAVY ELECTRICALS LTD

Dy. Mgr (SCT)

| Agency | Contact details | |
|---|---|---|
| BHEL, PSER, Kolkata | Address | DJ-9/1, Sector – II, Salt Lake, Kolkata – 700 091 |
| | Phone no | 033-2339 8236/8231/8000 |
| | FAX no | 033-23211960 |
| | E-mail | anupriya.mundu@bhel.in/ malini@bhel.in/subrata.sen@bhel.in |

Enclosure

01. Annexure-1: Pre Qualification Criteria.
02. Format-1 & Format-2/PQ Explanatory Note
03. Annexure-2: Format for No Deviation Certificate.
04. Annexure-3: Format for seeking clarification.
05. Annexure-4: Check List.
06. Annexure-5: Conditions for consortium/tie up.
07. Annexure –A- Amendment to GCC/SCC.
08. Annexure -B- Terms & conditions of Reverse Auction.
09. Annexure –C- CA certificate Format.
10. Annexure-D – Specific Clause w.r.t. BOCW Act & Cess Act.
11. Annexure-E- Statewise GST Registration nos.
12. Annexure– CPP-GST/I.
13. Form-2 (Format for local content)
14. Integrity Pact Agreement Format (Separate)
15. Other Tender documents as per this NIT.

ANNEXURE-1

PRE QUALIFICATION CRITERIA

| | |
|---|---|
| JOB | CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. |
| TENDER NO | PSER:SCT:NBN-C2067:20. |

| SL NO | CRITERIA |
|---|---|
| A | |
| 1.0 (a) | BIDDER SHOULD HAVE AVERAGE MINIMUM ANNUAL FINANCIAL TURNOVER OF INR 1713.25 LACS DURING THE LAST 3 (THREE) YEARS, ENDING ON 31-03-2019 OR CORRESPONDING FINANCIAL YEAR FOLLOWED BY THE BIDDER AND HAVING POSITIVE NET WORTH AS ON LATEST AUDITED ACCOUNTS AS SUBMITTED FOR PARA 1(C). |
| (b) | BIDDER MUST HAVE EARNED PROFIT IN ANY ONE OF THE LAST THREE FINANCIAL YEARS ENDING ON 31-03-2019 OR CORRESPONDING FINANCIAL YEAR FOLLOWED BY THE BIDDER. AUDITED BALANCE SHEET AND PROFIT & LOSS ACCOUNT OF THE COMPANY FOR LAST 3 (THREE) FINANCIAL YEARS, ENDING ON 31-03-2019 OR CORRESPONDING FINANCIAL YEAR FOLLOWED BY THE BIDDER NEED TO BE SUBMITTED IN SUPPORT OF ABOVE. |
| (c) | IN CASE AUDITED BALANCE SHEET AND PROFIT AND LOSS ACCOUNT HAS NOT BEEN SUBMITTED FOR ALL THREE YEARS INDICATED ABOVE THEN THE APPLICABLE FINANCIAL AUDITED STATEMENTS SUBMITTED BY THE BIDDERS AGAINST THE REQUISITE THREE YEARS WILL BE AVERAGED FOR THREE YEARS. |
| (d) | IF FINANCIAL STATEMENTS ARE NOT REQUIRED TO BE AUDITED STATUTORILY, THEN INSTEAD OF AUDITED FINANCIAL STATEMENTS, FINANCIAL STATEMENTS ARE REQUIRED TO BE CERTIFIED BY CHARTERED ACCOUNTANT. |
| 2.1 | BIDDER SHOULD HAVE EXECUTED PILING OR CIVIL OR STRUCTURE OR 'CIVIL AND STRUCTURAL WORKS' OR RCC CHIMNEY OR RCC COOLING TOWER OR RCC SILO OR MILL BUNKER OR ANY COMBINATION OF THESE IN THE LAST 7 (SEVEN) YEARS, ENDING ON THE LATEST DATE OF BID SUBMISSION, VALUE OF WHICH SHOULD NOT BE LESS THAN EITHER OF THE FOLLOWING :<br><br>A) 1 (SINGLE) WORK OF VALUE NOT LESS THAN INR 4568.66 LACS.<br>OR<br>B) 2 (TWO) WORKS OF VALUE NOT LESS THAN INR 2855.42 LACS EACH<br>OR<br>C) 3 (THREE) WORKS OF VALUE NOT LESS THAN INR 2284.33 LACS EACH<br><br>RELEVANT DOCUMENT IN SUPPORT OF ABOVE SHALL BE SUBMITTED. |
| 2.2 | BIDDER SHOULD HAVE EXECUTED FOLLOWING JOB IN ANY POWER PLANT / INDUSTRIAL PROJECT DURING LAST 7 (SEVEN) YEARS, ENDING ON THE LATEST DUE DATE OF SUBMISSION OF OFFER.;<br>A. AT LEAST SHELL OF ONE RCC CHIMNEY OF MINIMUM 100 MTR HEIGHT IN A RUNNING/COMPLETED CONTRACT.<br>OR<br>B. AT LEAST SHELL OF ONE NDCT (NATURAL DRAFT COOLING TOWER) OF MIMIMUM 60 MTR HEIGHT IN A RUNNING/COMPLETED CONTRACT.<br><br>RELEVANT DOCUMENT IN SUPPORT OF ABOVE SHALL BE SUBMITTED. |

| | |
|---|---|
| 3.0 | BIDDER SHOULD HAVE VALID PAN.<br><br>RELEVANT DOCUMENT IN SUPPORT OF ABOVE SHALL BE SUBMITTED. |
| 4.0 | CONSORTIUM/JV BIDDING IS NOT ALLOWED. |
| B | GENERAL |
| 1.0 | 'EXECUTED' MEANS BIDDER SHOULD HAVE ACHIEVED THE CRITERIA SPECIFIED ABOVE EVEN IF THE CONTRACT HAS NOT BEEN COMPLETED OR CLOSED. |
| 2.0 | BIDDER SHOULD FURNISH INFORMATION REGARDING PROJECTS IN HAND, CURRENT LITIGATION, ORDERS REGARDING EXCLUSION/ EXPULSION OR BLACK LISTING. |
| 3.0 | AFTER SATISFACTORY FULFILLMENT OF ALL THE ABOVE CRITERIA, OFFER SHALL BE CONSIDERED FOR FURTHER EVALUATION AS PER NIT AND ALL OTHER TERMS OF THE TENDER, SUBJECT TO CUSTOMER'S APPROVAL |
| 4.0 | BIDDER MUST NOT BE UNDER BANKRUPTCY CODE PROCEEDINGS (IBC) BY NCLT OR UNDER LIQUIDATION / BIFR, WHICH WILL RENDER HIM INELIGIBLE FOR PARTICIPATION IN THIS TENDER, AND SHALL SUBMIT UNDERTAKING TO THIS EFFECT. |

**Explanatory Notes for the PQR (unless otherwise specified in the PQR):**

1. Bidder to submit Audited Balance Sheet and Profit and Loss Account for the respective years as indicated along with all annexures.
2. In case audited Financial statements have not been submitted for all the three years as indicated, then the applicable audited statements submitted by the bidders against the requisite three years, will be averaged for three years i.e total divided by three.
3. Net Worth (Only in case of companies) of the bidder should be positive. Net worth shall be calculated based on the latest Audited Accounts as furnished.Net worth = Paid up share capital + Reserves.
4. PROFIT shall be PBT earned during any one year of last three financial years.
5. 'Additional' Criteria in respect of 'Technical' criteria of PQR for Civil, Electrical, CI, unless otherwise specified:

    i) 'Similar' work means
        a. Piling or Civil or Structure or 'Civil and Structural works' or RCC Chimney or RCC Cooling Tower or RCC Silo or Mill Bunker or any combination of these shall be considered similar works for all packages mentioned under 'CIVIL WORKS'
        b. Electrical or C&I or 'Electrical and C&I' shall be considered similar works for all packages mentioned under 'ELECTRICAL AND C&I WORKS'

6. For evaluation of PQR of Civil, Electrical and C&I packages, in case Bidder alone does not meet the 'Additional' pre-qualifying technical criteria, bidder may utilize the experience of its Parent/ Subsidiary Company along with its own experience, subject to following:
    a. The parent company shall have a controlling stake of ≥50% in the subsidiary company (as per Format-1).
    b. The Parent Company/ Subsidiary Company of which experience is being utilized for bidding shall submit Security Deposit(SD) equivalent to 1% of the total contract value.
    c. The parent/ subsidiary company and bidder shall provide an undertaking that they are jointly or severally responsible for successful performance of the contract (as per Format-2).
    d. In case Bidder is submitting bid as a Consortium Partner, option of utilizing experience of parent/subsidiary Company can availed by Prime Bidder only.
    e. Parent Company/ Subsidiary Company of which experience is being used for bidding, cannot participate as a 'Standalone Bidder' or as a 'Consortium bidder'.
7. Completion date for achievement of the technical criteria specified in the Common QR should be in the last 7 years ending on the 'latest date of Bid Submission' of Tender irrespective of date of the start of work.
8. 'EXECUTED' means the bidder should have achieved the criteria specified in the Technical criteria of PQR even if the Contract has not been completed or closed
9. In case the Experience/PO/WO certificate enclosed by bidders do not have separate break up of prices for the E&C portion for Electrical and C&I works (i.e. the certificates enclosed are for composite order for supply and erection of Electrical and C&I and other works if any), then value of Erection & Commissioning for the Electrical and C&I portion shall be considered as 15% of the price for supply & erection of Electrical and C&I.
10. Unless otherwise specified, for the purpose of "Technical Criteria" of PQR , the word 'EXECUTED' means achievement of milestones as defined below -
    - "ACHIEVEMENT OF PHYSICAL QUANTITIES" as per PQRs.
    - "READINESS FOR COAL FILLING" of at least one Bunker, in respect of Mill Bunker Structure.
    - "CHARGING" in respect of Power Transformers/ Bus Ducts/ "HT/LT Switchgears" / "HT/LT Cabling".
    - For C&I works: "SYNCHRONISATION" in case of power project / "WORK EXECUTION of the value as defined in PQR" in case of industry.
    - "BOILER LIGHT UP" in respect of Boiler / CFBC / ESP.
    - "CHARGING OF ATLEAST ONE PASS" in respect of ESP(R&M)
    - "GAS IN" in respect of HRSG.
    - "STEAM BLOWING" in respect of Power Cycle Piping.
    - "HYDRAULIC TEST"/ ANY OTHER EQUIVALENT TEST LIKE "100% RT/UT OF WELDED JOINTS" of the system in respect of Pressure parts/ LP Piping/CW Piping.
    - "FULL LOAD OPERATION OF THE UNIT" in respect of Insulation work.
    - "SYNCHRONISATION" in respect of STG / GTG.
    - "SPINNING" in respect of HTG.
    - "GAS IN" in respect of FGD
11. Boiler means HRSG or WHRB or any other types of Steam Generator

12. Power Cycle piping means Main Steam, Hot Reheat, Cold Reheat, HP Bypass
13. For the purpose of evaluation of the PQR, one MW shall be considered equivalent to 3.5 TPH where ever rating of HRSG/BOILER is mentioned in MW. Similarly, where ever rating of Gas Turbine is mentioned in terms of Frame size, ISO rating of the same in terms of MW shall be considered for evaluation.
14. Value of work is to be updated with indices for "All India Avg. Consumer Price index for industrial workers" and "Monthly Whole Sale Price Index for All Commodities" with base month as per last month of work execution and indexed up to three (3) months prior to the month of latest due date of bid submission as per following formula-

$$P = R + 0.425 \times R \times \frac{(X_N - X_0)}{X_0} + 0.425 \times R \times \frac{(Y_N - Y_0)}{Y_0}$$

Where

P = Updated value of work

R = Value of executed work

$X_N$ = All India Avg. Consumer Price index for industrial workers for three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 02-Mar-17, then bid submission month shall be reckoned as March'17 and index for Dec'2016 shall be considered).

$X_0$ = All India Avg. Consumer Price index for industrial workers for last month of work execution

$Y_N$ = Monthly Whole Sale Price Index for All Commodities for three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 02-Mar-17, then bid submission month shall be reckoned as March'17 and index for Dec'2016 shall be considered).

$Y_0$ = Monthly Whole Sale Price Index for All Commodities for last month of work execution

15. Bidder must not be under Bankruptcy Code Proceedings (IBC) by NCLT or under Liquidation / BIFR, which will render him ineligible for participation in this tender, and shall submit undertaking to this effect.

Format-1 /PQ Explanatory Note

**Certificate for relationship between Parent Company / Subsidiary Company and the bidder**

To,
…….

…….

Dear Sir,

**Sub:** Bid for NIT No ……..dated……. for "……." (name of the tender).

We hereby certify that M/s……..…… is Parent Company/ Subsidiary Company of M/s ..... ……(the bidder) and details of equity holding of the Parent Company in Subsidiary Company as on ……(not earlier than seven days prior to the Bid Submission Date) are given as below:

| Name of Parent Company | Name of Subsidiary Company | Percentage of Equity Holding of Parent Company in Subsidiary Company |
|---|---|---|
| | | |

**(Insert Name and Signature of Statutory Auditor or practicing Company Secretary of the Bidder)**

Format-2 /PQ Explanatory Note

**Undertaking from the Parent Company/ Subsidiary Company of the bidder**

***(On the Letter Head of Parent Company/ Subsidiary Company, as applicable)***

From,
Name:
Full Address:

Telephone No.:
E-mail address:
Fax/No.:

To,
……..
……..

Dear Sir,

We refer to the NIT No..... dated…… for "……" (name of the Tender).

"We have carefully read and examined in detail the NIT/Tender Terms and Conditions, including in particular, Clause .... of the NIT/Tender, regarding submission of an Undertaking, as per the prescribed Format 1 of the NIT/ Tender.

We confirm that M/s……(the Bidder) has been authorized by us to use our Technical capability for meeting the Technical Criteria as specified in Clause……..of the PQR of the NIT/Tender referred above.

We agree to submit the Security Deposit equivalent to 1% of the total contract value in addition to Security Deposit to be submitted by Bidder as per Clause…….....of the NIT/Tender for fulfillment of all obligations in terms of provisions of the contract, in the event of ……..(the Bidder) being selected as the Successful Bidder.

We confirm that we along with M/s……(the bidder), are jointly or severally responsible for successful performance of the contract.
We confirm that our company shall not participate in the above tender as a 'Standalone Bidder' or as a 'Consortium bidder' and also shall not authorize any other bidder to use our Technical capability for the above tender.

All the terms used herein but not defined, shall have the meaning as ascribed to the said terms under the referred NIT/Tender.

**Signature of Managing Director/Authorized signatory of Parent/ Subsidiary Company**

**ANNEXURE - 2**

**FORMAT FOR NO DEVIATION CERTIFICATE**
**(To be submitted in the bidder's letter head)**

BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector - Eastern Region,
Plot no 9/1, DJ Block, Sector – II, Salt Lake City,
Kolkata – 700 091

| | | |
|---|---|---|
| Sub | No Deviation Certificate. | |
| Job | Construction of 4 nos 150 M Tall Single Flue RCC Chimney with Borosilicate Glass Block Lining System on MS Flue Can (excluding pile) at 4x250 MW BRBCL Nabinagar TPP FGD, Bihar. | |
| Ref | 1.0 | Tender no PSER:SCT:NBN-C2067:20. |
| | 2.0 | BHEL's NIT, vide reference no PSER:SCT:NBN-C2067:8042 Date: 14-07-2020. |
| | 3.0 | All other pertinent issues till date. |

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed/ modified the tender documents as appeared in the website/ issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above referred NIT. We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification, integrity pact (if applicable) and acceptance to reverse auctioning process.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted/uploaded offer/documents in accordance with tender instructions with acceptance of the terms & conditions of the tender by us and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized
representative of the bidder)

**ANNEXURE - 3**

## FORMAT FOR SEEKING CLARIFICATION

| | |
|---|---|
| **JOB** | Construction of 4 nos 150 M Tall Single Flue RCC Chimney with Borosilicate Glass Block Lining System on MS Flue Can (excluding pile) at 4x250 MW BRBCL Nabinagar TPP FGD, Bihar.. |
| **TENDER NO** | PSER:SCT:NBN-C2067:20. |

| Sl no | Reference clause of tender document | Existing provision | Bidder's query | BHEL's clarification |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**ANNEXURE - 4**

CHECK LIST

NOTE:- Tenderers are required to fill in the following details and no column should be left blank

| | | |
|---|---|---|
| 1 | Name and Address of the Tenderer | |
| 2 | Details about type of the Firm/Company | |
| 3.a | Details of Contact person for this Tender | Name : Mr/Ms<br>Designation:<br>Telephone No:<br>Mobile No:<br>Email ID:<br>Fax No: |
| 3.b | Details of alternate Contact person for this Tender | Name : Mr/Ms<br>Designation:<br>Telephone No:<br>Mobile No:<br>Email ID:<br>Fax No: |
| 4 | EMD DETAILS | DD No: Date :<br>Bank : Amount:<br>Please tick ( √ ) whichever applicable:-<br>ONE TIME EMD / ONLY FOR THIS TENDER |
| 5 | Validity of Offer | TO BE VALID FOR SIX MONTHS FROM DUE DATE |

| | | APPLICABILITY(BY BHEL) | ENCLOSED BY BIDDER |
|---|---|---|---|
| 6 | Whether the format for compliance with PRE QUALIFICATION CRITERIA (ANNEXURE-I) is understood and filled with proper supporting documents referenced in the specified format | Applicable | YES / NO |
| 7 | Audited profit and Loss Account for the last three years | Applicable/Not Applicable | YES/NO |
| 8 | Copy of PAN Card | Applicable/Not Applicable | YES/NO |
| 9 | Whether all pages of the Tender documents including annexures, appendices etc are read understood and signed | Applicable/Not Applicable | YES/NO |
| 10 | Integrity Pact | Applicable/Not Applicable | YES/NO |
| 11 | Declaration by Authorised Signatory | Applicable/Not Applicable | YES/NO |
| 12 | No Deviation Certificate | Applicable/Not Applicable | YES/NO |
| 13 | Declaration confirming knowledge about Site Conditions | Applicable/Not Applicable | YES/NO |
| 14 | Declaration for relation in BHEL | Applicable/Not Applicable | YES/NO |
| 15 | Non Disclosure Certificate | Applicable/Not Applicable | YES/NO |
| 16 | Bank Account Details for E-Payment | Applicable/Not Applicable | YES/NO |
| 17 | Capacity Evaluation of Bidder for current Tender | Applicable/Not Applicable | YES/NO |
| 18 | Tie Ups/Consortium Agreement are submitted as per format | Applicable/Not Applicable | YES/NO |
| 19 | Power of Attorney for Submission of Tender/Signing Contract Agreement | Applicable/Not Applicable | YES/NO |
| 20 | Analysis of Unit rates | Applicable/Not Applicable | YES/NO |
| 21 | Bankruptcy Code Proceedings (IBC) by NCLT or under Liquidation / BIFR (Undertaking to be enclosed if not applicable) | Applicable/Not Applicable | YES/NO |

NOTE: STRIKE OFF 'YES' OR 'NO', AS APPLICABLE. TENDER NOT ACCOMPANIED BY THE PRESCRIBED ABOVE APPLICABLE DOCUMENTS ARE LIABLE TO BE SUMMARILY REJECTED.

DATE :

AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

ANNEXURE-5

CONDITIONS TO BE COMPLIED WITH FOR CONSORTIUM BIDDING (TECHNICAL TIE UP)

1 Prime Bidder and Consortium Partner or partners are required to enter into a consortium agreement with a validity period of six months initially. In case the consortium is awarded the contract, then the Consortium Agreement between the Prime Bidder and Consortium Partner or partners shall be extended till contractual completion period including extension periods if any applicable. The Prime Bidder and Consortium Partner(s) shall certify to BHEL regarding existence and validity of their consortium agreement on six monthly basis.

2 Standalone' bidder cannot become a 'Prime Bidder' or a 'Consortium bidder' or 'Technical Tie up bidder' in a consortium (or Technical Tie up) bidding. Prime bidder shall neither be a consortium partner to other prime bidder nor take any other consortium partners. However, consortium partner may enter into consortium agreement with other prime bidders. In case of non compliance, consortium bids of such Prime bidders will be rejected.

3 Number of partners for a consortium Bidding (or Technical Tie up) shall be as specified in the PQR.

4 Prime Bidder shall be as specified in the Pre Qualification Requirement, else the bidder who has the major share of work.

5 In order to be qualified for the tender, Prime Bidder and Consortium partner or partners shall satisfy (i) the Technical 'Pre Qualifying Requirements' specified for the respective package, (ii) "Assessment of Capacity of Bidder' as specified in clause 8.0

6 Prime Bidder shall comply with additional 'Technical' criteria of PQR as defined in 'Explanatory Notes for the PQR'

7 Prime Bidder shall comply with all other Pre Qualifying criteria for the Tender unless otherwise specified

8 In case customer approval is required, then Prime Bidder and Consortium Partner or partners shall have to be individually approved by Customer for being considered for the tender.

9 Prime Bidder shall be responsible for the overall execution of the contract

10 In case of award of job, Performance shall be evaluated for Prime Bidder and Consortium Partner or partners for their respective scope of work(s) as per prescribed formats.

11 In case the Consortium partner or partners back out, their SDs shall be encashed by BHEL. In such a case, other consortium partner or partners meeting the PQR have to be engaged by the Prime Bidder, and if not, the respective work will be withdrawn and executed on risk and cost basis of the Prime Bidder. The new consortium partner or partners shall submit fresh SDs as applicable.

12 In case the prime Bidder withdraws, the whole contract shall be considered cancelled and short closed.

13 After successful execution of one work with a consortium partner under direct orders of BHEL, the Prime Bidder shall be eligible for becoming a 'standalone' bidder for works similar to that for which consortium partner was engaged, for subsequent tenders.

14 The consortium partner shall submit SD equivalent to 1% of the total contract value in addition to the SD to be submitted by the prime Bidder for the total contract value. In case there are two consortium partners, then each partner shall submit SD equivalent to 0.5% of the total contract value in addition to the SD to be submitted by the prime Bidder for the total contract value.

15 In case of a Technical Tie up, all the clauses applicable for the Consortium partner shall be applicable for the Technical Tie up partner also.

Annexure - A

Amendment to GCC/SCC

1. Introduction of Clause No 1.15.13 in GCC as below:

Clause No 1.15.13: Additional security deposit (SD) has to be submitted by the successful bidder with value as follows:

"If the final price of successful bidder is lesser by 'more than 20%' of BHEL's estimate - 'Additional Security Deposit' will be required to be submitted by the successful bidder with value as follows:

Additional Security Deposit = 30 % of (A-B) limited to a maximum of 10% of the 'Total Price/Contract Value', where,

A = 80% of BHEL estimate

B = The final offered price of successful bidder through RA (In case of RA)

OR

Sealed paper price bid of successful bidder (in case of paper bid)

This 'Additional Security Deposit' shall have the same validity as that of the 'Security Deposit' and shall be revalidated/released in the manner as spelt out for the 'Security Deposit' as per relevant clause of GCC.

The BHEL's estimated value shall be disclosed to the successful bidder (on their request) at appropriate juncture in case 'Additional Security Deposit' is applicable."

2. Clause no. 1.9.1(ii) of GCC shall be read as below:

The EMD may be accepted only in the following forms:

(a) Cash deposit as permissible under the extant Income Tax Act (before tender opening)

(b) Electronic Fund Transfer credited in BHEL account (before tender opening)

(c) Banker's cheque/ Pay order/ Demand draft, in favour of BHEL (along with offer)

(d) Fixed Deposit Receipt (FDR) issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act (FDR should be in the name of the Contractor, a/c BHEL).

In addition to above, the EMD amount in excess of Rs. 2 Lakh may also be accepted in the form of Bank Guarantee from scheduled bank. The Bank Guarantee in such cases shall be valid for at least six months. EMD of successful tenderer will be retained as part of Security Deposit.

Clause no. 1.9.1(iv) & (v) of GCC stands deleted.

3. Clause no. 1.10.1 of GCC shall be read as below:

The total amount of Security Deposit will be 5% of the contract value. EMD of the successful tenderer shall be converted and adjusted towards the required amount of Security Deposit.

4. Clause no. 1.10.2 of GCC shall be read as below:

At least 50% of the required Security Deposit, including the EMD, should be furnished before start of the work. Balance of the Security Deposit can be deposited by deducting 10% of the gross amount progressively

from each of the running bills of the Contractor till the total amount of the required Security Deposit is collected.

The recoveries made from running bills (cash deduction towards balance SD amount) can be released against submission of equivalent Bank Guarantee in acceptable form, but only once, before completion of work, with the approval of competent authorities.

5. Clause no. 1.10.3 of GCC shall be read as below:

The balance amount to make up the required Security Deposit of 5% of the contract value may be accepted in the following forms:

a) Cash (as permissible under the extant Income Tax Act)
b) Local cheques of Scheduled Banks (subject to realization)/ Pay Order/ Demand Draft/ Electronic Fund Transfer in favour of BHEL
c) Bank Guarantee from Scheduled Banks/ Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format should have the approval of BHEL
d) Fixed Deposit Receipt issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act (FDR should be in the name of the Contractor, a/c BHEL)
e) Securities available from Indian Post offices such as National Savings Certificates, Kisan Vikas Patras etc. (held in the name of Contractor furnishing the security and duly endorsed/ hypothecated/ pledged, as applicable, in favour of BHEL)

(Note: BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith)

6. Introduction of Clause No. 1.10.8 in GCC as below:

Clause No 1.10.8: SDBG to be furnished by the vendor before start of work. No payment will be released till SDBG is submitted by the vendor.
If requested by the vendor, cash recovery equivalent to SDBG value to be made from bills submitted by the vendor.
Also recovery of interest calculated @SBI PLR +2% on amount equivalent to SDBG / PBG value to be made for the gap period (difference between date of start of work and date of submission of BG / cash recovery).
In case of delay in extension of SDBG, in case of validity expiry, SDBG shall be invoked. However if the vendor submits a new BG after invocation of the previous BG then, it shall be refunded and recovery for the gap period, i.e. the duration for which BG is not available shall be made as stated above.

7. Clause no. 1.11 of GCC shall be read as below:

Security Deposit shall be refunded/Bank Guarantee(s) released to the Contractor along with the 'Final Bill' after deducting all expenses / other amounts due to BHEL under the contract / other contracts entered into with them by BHEL upon fulfilment of contractual obligations as per terms of the contract.

8. Clause no. 2.8.3, 2.8.4 and 2.8.5 of GCC shall be read as below:

Clause no. 2.8.3: The contractor shall comply with all applicable State and Central Laws, Statutory Rules, Regulations, Notifications, etc. such as Payment of Wages Act, Minimum Wages Act, Workmen Compensation Act, Employer's Liability Act, Industrial Disputes Act, Employers Provident Act, Employees State Insurance Scheme, Contract Labour (Regulation and Abolition) Act, 1970, Payment of Bonus & Gratuity Act, Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996, The Building and Other Construction Workers' Welfare Cess Act, 1996 and other Acts, Rules, and Regulations for labour/workers as applicable and as may be enacted by the State Government and Central Govt. during the tenure of the Contract and having force or jurisdiction at Site. The Contractor shall also comply with provisions of and give all such

notices to the local Governing Body, Police and other relevant Authorities as may be required by the Law.

Clause no. 2.8.4: The Contractor shall obtain independent License under the Contract Labour (Regulations and Abolition) Act, 1970 for engaging contract labour as required from the concerned Authorities based on the certificate (Form- V) issued by the Principal Employer/Customer.

Clause no. 2.8.5: The contractor shall pay and bear all taxes, fees, license charges, Cess, duties, deposits, tolls, royalties, commission or other charges which may be leviable on account of his operations in executing the contract.

9. Clause 2.12 of GCC (Overrun Compensation)

2.12 OVERRUN COMPENSATION (ORC)

2.12.1 ORC during original contract period: No ORC shall be applicable during the original contract period.

2.12.2 ORC during extended period for the reasons solely attributable to contractor: No ORC shall be applicable during the extended period granted for the reasons solely attributable to contractor and work executed during this period shall be paid as per original contract rates.

2.12.3 ORC during extended period for the reasons not attributable to contractor: ORC shall be payable as per following procedure:

2.12.3.1 For initial period of twelve months of extended period, ORC rate applicable over executed value shall be 5%. For every subsequent period of twelve months, ORC rate shall be further increased by 5% over the previous rate. For example, ORC rates applicable for initial period of 12 months and subsequent period of 12 months are given below.

| Sl. No. | Extended Period for the reasons attributable to BHEL | ORC rate applicable over executed value |
|---|---|---|
| 1 | First 12 months | 5% |
| 2 | 13th-24th month and so on | 10.25%<br>{[(1.05 x 1.05)-1] x 100} |

This process of increasing ORC rate for each subsequent period of 12 months shall continue till applicability of ORC.

2.12.3.2 On completion of original contract period as well as on completion of each subsequent period of twelve months i.e. at the time of change in applicable ORC rate, Delay Analysis shall be carried out and percentage shortfall attributable to both BHEL & Contractor shall be calculated.

2.12.3.3 For the purpose of calculation of ORC, executed value of work in the month shall be divided in Part-1 and Part-2 in proportion of percentage shortfall attributable to BHEL and contractor respectively, based on the last delay analysis as worked out in 2.12.3.2.
ORC shall be payable only on Part-1 and no ORC shall be payable on Part-2.

Value of Part-1 shall be further limited to the value of actual inputs provided by BHEL i.e. "Plan - Shortfall attributable to BHEL" for the month, as per Form-14 for calculation of ORC.

2.12.3.4 Payment of ORC amount shall be further regulated as follows:

(i) 50% of the ORC is allocated for deployment of matching resources (with weightages) agreed as per the joint programme drawn vide 2.11.4. ORC Payment against resources shall be calculated in proportion to percentage of resources actually deployed w.r.t. planned resources, as per Form-14.

(ii) 50% of ORC is allocated for achieving of planned progress agreed as per the joint programme drawn vide 2.11.4. ORC Payment shall be reduced in proportion to percentage shortfall attributable to contractor w.r.t. "Plan - Shortfall attributable to BHEL" for the month, as per Form-14.

2.12.3.5 The maximum amount of ORC payable for the month shall be limited to Rs. 5,00,000/-.

2.12.3.6 In case, there is no shortfall attributable to contractor for the month and also contractor has deployed the resources as agreed in Form-14 but ORC amount payable for the month worked out as per procedure mentioned in clause 2.12.3.3, 2.12.3.4 and 2.12.3.5, is less than Rs.1,00,000/-, then ORC amount payable for the month shall be Rs.1,00,000/- otherwise ORC amount payable for the month shall remain same.

2.12.3.7 In case execution is on HOLD (Other than Force Majeure), ORC shall be payable as per following:

i). Contractor has not been permitted by BHEL to de-mobilize
   a) ORC amount of Rs. 1,00,000/- per month shall be applicable during the period of HOLD provided resources as planned are deployed (not demobilised) during the period of hold.
   b) Subsequent to lifting of HOLD, Period of HOLD shall not be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.

ii). Contractor has been permitted to demobilize and to remobilize after lifting of HOLD
   a) No ORC shall be payable to contractor for the period of HOLD.
   b) Subsequent to lifting of HOLD, Period of HOLD shall not be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.

2.12.3.8 In case Force Majeure is invoked:
   (i) No ORC shall be applicable during the period of Force Majeure.
   (ii) Subsequent to revocation of Force Majeure, period of Force Majeure shall be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.

2.12.4 Applicability of ORC: ORC shall not be applicable for following activities.
   (i) Area cleaning, removal of temporary structures and return of scrap.
   (ii) Punch list points / pending points liquidation pending due to reasons attributable to contractor
   (iii) Submission of "As built Drawing"
   (iv) Material Reconciliation
   (v) Completion of Contract Closure formalities like HR Clearance/ No dues from various dept./ Statutory Authorities etc.

2.12.5 Total Over Run Compensation shall be limited to 10% of the cumulatively executed contract value till the month (excluding Taxes and Duties if payable extra). For this purpose, executed contract value excludes PVC, ORC and Extra/Supplementary Works.

10. Clause 2.14 of GCC (Quantity Variation)

a) Existing Clause 2.14.1 of GCC stands revised as follows:

"The quantities given in the contract are tentative and may change to any extent (both in plus side and minus side). The quoted rates for individual items shall remain firm irrespective of any variations in the individual quantities No compensation becomes payable in case the variation of the final executed contract value is within the limit of Minus (-) 15% of awarded contract value"

b) Existing Clause 2.14.2 ii). of GCC stands revised as follows:

"In case the finally executed contract value increases above the awarded Contract Value due to quantity variation, there will be no upward revision in the rates for the individual items and also contractor is not eligible for any compensation."

11. Clause 2.17 of GCC (Price Variation Compensation) stands revised as follows:

## 2.17 PRICE VARIATION COMPENSATION

2.17.1 In order to take care of variation in cost of execution of work on either side, due to variation in the index of LABOUR, HIGH SPEED DIESEL OIL, WELDING ROD, CEMENT, STEEL, MATERIALS,
Price Variation Formula as described herein shall be applicable (only for works executed during extended period, if any, subject to other conditions as described in this section)

2.17.2 85% component of Contract Value shall be considered for PVC calculations and remaining 15% shall be treated as fixed component. The basis for calculation of price variation in each category, their component, Base Index shall be as under:

| SL NO | CATEGORY | BASE INDEX | PERCENTAGECOMPONENT('K') | | | | |
|---|---|---|---|---|---|---|---|
| | | | CIVIL PACKAGES (See Note A/B/C) | | | MECHANICAL PACKAGES | Electrical, C&I Material Management/Handling and other labour oriented packages |
| | | | A | B | C | | |
| i) | LABOUR (ALL CATEGORIES) | 'MONTHLY ALL-INDIA AVERAGE CONSUMER PRICE INDEX NUMBERS FOR INDUSTRIAL WORKERS' published by Labour Bureau, Ministry of Labour and Employment, Government of India. (Website: labourbureau.nic.in) | 40 | 25 | 30 | 65 | 80 |
| ii) | HIGH SPEED DIESEL OIL | Name of Commodity: HSD<br>Commodity Code: 1202000005 (See Note E) | 5 | 3 | 5 | 5 | 5 |
| iii) | WELDING ROD | Name of Commodity: MANUFACTURE OF BASIC METALS<br>Commodity Code: 1314000000 (See Note E) | | | | 15 | |
| iv) | CEMENT | Name of Commodity: ORDINARY PORTLAND CEMENT<br>Commodity Code: 1313050003 (See Note E) | | 20 | 30 | | |
| v) | STEEL (Structural and Reinforcement Steel) | Name of Commodity: MILD STEEL: LONG PRODUCTS<br>Commodity Code: 1314040000 (See Note E) | | 25 | | | |
| vi) | All OTHER MATERIALS (Other than Cement & Steel) | Name of Commodity: ALL COMMODITIES<br>Commodity Code:1000000000 (See Note E) | 40 | 12 | 20 | | |

Note: A) Cement & Steel:Free Issue (BHEL Scope)
B) Cement & Steel :In Contractor Scope
C) Cement in Contractor Scope, and Steel is Free Issue (BHEL Scope)
D) For Composite packages (i.e. Civii+Mechanicai+Eiectrical and/or CI or Civil+Mechanical or Mechanicai+Eiectrical and/or CI}, the COMPONENT ('K') for various categories shall be as per respective packages as above.

E) As per the 'MONTHLY WHOLE SALE PRICE INDEX' for the respective Commodity and Type, published by Office of Economic Adviser, Ministry of Commerce and Industry, Government of India. (Website: http://eaindustry.nic.in/home.asp). Revisions in the index or commodity will be re adjusted accordingly.

2.17.3 #

2.17.4 Payment/recovery due to variation in index shall be determined on the basis of the following notional formula in respect of the identified COMPONENT ('K') viz LABOUR, HIGH SPEED DIESEL OIL, WELDING ROD, CEMENT, STEEL, MATERIALS.

$$P = K \times R \times \frac{(X_N - Xo)}{Xo}$$

Where

P =Amount to be paid/recovered due to variation in the Index for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials

K = Percentage COMPONENT ('K') applicable for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials

R=Value of work done for the billing month (Excluding Taxes and Duties if payable extra)

$X_N$ = Revised Index for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials for the billing month under consideration

Xo = Index for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials as on the Base date

2.17.5 Base date shall be the calendar month of the schedule completion date (i.e. Actual start date+ Scheduled Contractual completion period as per Letter of Intent/award and/or work order).

2.17.6 PVC shall not be payable for the ORC amount, Supplementary/Additional Items, Extra works.
However, PVC will be payable for items executed under quantity variation of BOQ items under originally awarded contract.

2.17.7 The contractor shall furnish necessary monthly bulletins in support of the requisite indices from the relevant websites along with his Bills.

2.17.8 The contractor will be required to raise the bills for price variation payments on a monthly basis along with the running bills irrespective of the fact whether any increase/decrease in the index for relevant categories has taken place or not. In case there is delay in publication of bulletins (final figure), the provisional values as published can be considered for payments and arrears shall be paid/recovered on getting the final values.

2.17.9 PVC shall be applicable only, during the extended period of contract (if any) after the scheduled completion period and for the portion of work delayed / backlog for the reasons not attributable to the Contractor.

However total quantum of Price Variation amount payable/recoverable shall be regulated as follows:

i. For the portion of shortfall / backlog not attributable to contractor, PVC shall be worked out on the basis of indices applicable for the respective month in which work is done. Base index shall be applicable as defined in clause 2.17.5

ii. In case of Force majeure, PVC shall be regulated as per (a) or (b) below:

a) Force majeure is invoked before "base date"/ “revised base date" (as explained below) OR immediately after "base date"/ “revised base date" in continuation (i.e. during the period when PVC is not applicable):

1. Base date shall be revised: Revised base date =Previous base date+ duration of Force majeure. No PVC will be applicable for the work done till revised base date.

2. PVC will be applicable for the work done after "base date"/ “revised base date" as the case may be (during extended period when delay is not attributable to contractor). PVC shall be worked out on the basis of

indices applicable for the respective month in which work is done with base index as on "base date"/"revised base date" as the case may be.

b) Force majeure is invoked after "base date"/ "revised base date" as the case may be (during extended period when delay is not attributable to contractor) -

1. PVC shall be applicable for the work done after revocation of force majeure.
2. PVC for the work done after revocation of force majeure shall be worked out on the basis of indices applicable for the respective month in which work is done excluding the effect of change in indices during total period of Force majeure(s) invoked after "base date"/ "revised base date" as the case may be. Base index shall be taken as on "base date"/ "revised base date" as the case may be.

iii. The total amount of PVC shall not exceed 15% of the cumulatively executed contract value. Executed contract value for this purpose is exclusive of PVC, ORC, Supplementary/Additional Items and Extra works except extra items due to quantity variation.

12. Clause 2.2 of GCC (Law governing the contract and court jurisdiction) stands revised as follows:

"The contract shall be governed by the Law for the time being in force in the Republic of India. Subject to Clause 2.21.1 or 2.21.2 of this Contract, the Civil Court having original Civil Jurisdiction at Delhi for PSNR, at Kolkata for PSER, at Nagpur for PSWR and at Chennai for PSSR, shall alone have exclusive jurisdiction in regard to all matters in respect of the Contract."

13. Existing Clause 2.21 "ARBITRATION" of GCC has been amended as follows:

2.21 ARBITRATION & CONCILIATION

2.21.1 ARBITRATION:

2.21.1.1 Except as provided elsewhere in this Contract, in case Parties are unable to reach amicable settlement (whether by Conciliation to be conducted as provided in Clause 2.21.2 herein below or otherwise) in respect of any dispute or difference; arising out of the formation, breach, termination, validity or execution of the Contract; or, the respective rights and liabilities of the Parties; or, in relation to interpretation of any provision of the Contract; or. in any manner touching upon the Contract (hereinafter referred to as the 'Dispute'), then, either Party may, commence arbitration in respect of such Dispute by issuance of a notice in terms of section 21 of the Arbitration & Conciliation Act, 1996 (hereinafter referred to as the 'Notice'). The Notice shall contain the particulars of all claims to be referred to arbitration in sufficient detail and shall also indicate the monetary amount of such claim. The arbitration shall be conducted by a sole arbitrator to be appointed by the Head of the BHEL Power Sector Region issuing the Contract within 60 days of receipt of the complete Notice. The language of arbitration shall be English.

The Arbitrator shall pass a reasoned award.

Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder as in force from time to time shall apply to the arbitration proceedings under this clause. The seat of arbitration shall be Kolkata (the place from where the contract is Issued). The Contract shall be governed by and be construed as per provisions of the laws of India. Subject to this provision 2.21.1.1 regarding ARBITRATION, the principal civil court exercising ordinary civil jurisdiction over the area where the seat of arbitration is located shall have exclusive jurisdiction over any DISPUTE to the exclusion of any other court.

2.21.1.2 In case of Contract with Public Sector Enterprise (PSE) or a Government Department, the following shall be applicable:

In the event of any dispute or difference relating to the interpretation and application of the provisions of commercial contract(s) between Central Public Sector Enterprises (CPSEs)/ Port Trusts inter se and also between CPSEs and Government Departments/Organizations (excluding disputes concerning Railways, Income Tax, Customs & Excise Departments), such dispute or difference shall be taken up by either party for resolution through AMRCD (Administrative Mechanism for Resolution of CPSEs Disputes) as mentioned in DPE OM No. 4(1)/2013-DPE(GM)/FTS-1835 dated 22-05-2018 as amended from time to time.

2.21.1.3 The cost of arbitration shall initially be borne equally by the Parties subject to the final allocation thereof as per the award/order passed by the Arbitrator.

2.21.1.4 Notwithstanding the existence of any dispute or differences and/or reference for the arbitration, the Contractor shall proceed with and continue without hindrance the performance of its obligations under this Contract with due diligence and expedition in a professional manner unless the dispute inter-alia relates to cancellation, termination or short-closure of the Contract by BHEL.

2.21.2 CONCILIATION:

If at any time (whether before, during or after the arbitral or judicial proceedings), any Disputes (which term shall mean and include any dispute, difference, question or disagreement arising in connection with construction, meaning, operation, effect, interpretation or breach of the agreement, contract), which the Parties are unable to settle mutually, arise inter-se the Parties, the same may, be referred by either party to Conciliation to be conducted through Independent Experts Committee (IEC) to be appointed by competent authority of BHEL from the BHEL Panel of Conciliators.

Notes:

1. No serving or a retired employee of BHEL/Administrative Ministry of BHEL shall be included in the BHEL Panel of Conciliators.

2. Any other person(s) can be appointed as Conciliator(s) who is/are mutually agreeable to both the parties from outside the BHEL Panel of Conciliators.

The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided in Procedure 2.3 to this GCC. The Procedure 2.3 together with its Formats will be treated as if the same is part and parcel hereof and shall be as effectual as if set out herein in this GCC.

The Contractor hereby agrees that BHEL may make any amendments or modifications to the provisions stipulated in the Procedure 2.3 to this GCC from time to time and confirms that it shall be bound by such amended or modified provisions of the Procedure 2.3 with effect from the date as intimated by BHEL to it.

2.21.3 No Interest payable to Contractor

Notwithstanding anything to the contrary contained in any other document comprising in the Contract, no interest shall be payable by BHEL to Contractor on any moneys or balances including but not limited to the Security Deposit, EMD, Retention Money, RA Bills or the Final Bill, or any amount withheld and/or appropriated by BHEL etc., which becomes or as the case may be, is adjudged to be due from BHEL to Contractor whether under the Contract or otherwise.

14. Clause no. 2.7.2 and 2.7.3 of Volume-IB-GCC shall be revised as follows:

2.7.2.1 To terminate the contract or withdraw portion of work and get it done through other agency, at the risk and cost of the contractor after due notice <u>of a period of 14 days' by BHEL</u> in any of the following cases:

i). Contractor's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to contractor including unexecuted portion of work does not appear to be executable within balance available period considering its performance of execution.
ii). Withdrawal from or abandonment of the work by contractor before completion of the work as per contract.
iii). Non-completion of work by the Contractor within scheduled completion period as per Contract or as extended from time to time, for the reasons attributable to the contractor.
iv). Termination of Contract on account of any other reason (s) attributable to Contractor.
v). Assignment, transfer, subletting of Contract without BHEL's written permission.
vi). Non-compliance to any contractual condition or any other default attributable to Contractor.

Risk & Cost Amount against Balance Work:

Risk & Cost amount against balance work shall be calculated as follows: Risk & Cost Amount= [(A-B) + (A x H/100)]
Where,
A= Value of Balance scope of Work (*) as per rates of new contract
B= Value of Balance scope of Work (*) as per rates of old contract being paid to the contractor at the time of termination of contract i.e. inclusive of PVC & ORC, if any.
H = Overhead Factor to be taken as 5

In case (A-B) is less than 0 (zero), value of (A-B) shall be taken as 0 (zero).

* Balance scope of work (in case of termination of contract):
Difference of Contract Quantities and Executed Quantities as on the date of issue of Letter for 'Termination of Contract', shall be taken as balance scope of Work for calculating risk & cost amount. Contract quantities are the quantities as per original contract. If, Contract has been amended, quantities as per amended Contract shall be considered as Contract Quantities.
Items for which total quantities to be executed have exceeded the Contract Quantities based on drawings issued to contractor from time to time till issue of Termination letter, then for these items total Quantities as per issued drawings would be deemed to be contract quantities.
Substitute/ extra items whose rates have already been approved would form part of contract quantities for this purpose. Substitute/ extra items which have been executed but rates have not been approved, would also form part of contract quantities for this purpose and rates of such items shall be determined in line with contractual provisions.
However, increase in quantities on account of additional scope in new tender shall not be considered for this purpose.

NOTE: Incase portion of work is being withdrawn at risk & cost of contractor instead of termination of contract, contract quantities pertaining to portion of work withdrawn shall be considered as 'Balance scope of work' for calculating Risk & Cost amount.

LD against delay in executed work in case of Termination of Contract:

LD against delay in executed work shall be calculated in line with LD clause no. 2.7.9 of GCC, for the delay attributable to contractor. For limiting the maximum value of LD, contract value shall be taken as Executed Value of work till termination of contract.

Method for calculation of "LD against delay in executed work in case of termination of contract" is given below.

i). Let the time period from scheduled date of start of work till termination of contract excluding the period of Hold (if any) not attributable to contractor = T1
ii) Let the value of executed work till the time of termination of contract= X
iii) Let the Total Executable Value of work for which inputs/fronts were made available to contractor and were planned for execution till termination of contract = Y
iv) Delay in executed work attributable to contractor i.e. T2=[1-(X/Y)] x T1
v) LD shall be calculated in line with LD clause (clause 2.7.9) of the Contract for the delay attributable to

contractor taking "X" as Contract Value and "T2" as period of delay attributable to contractor.

2.7.2.2 In case Contractor fails to deploy the resources as per requirement, BHEL can deploy own/hired/otherwise arranged resources at the risk and cost of the contractor and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.

2.7.3 Recoveries arising out of Risk & Cost and LD or any other recoveries due from Contractor

Following sequence shall be applicable for recoveries from contractor:

a) Dues available in the form of Bills payable to contractor, SD, BGs against the same contract.
b) Demand notice for deposit of balance recovery amount shall be sent to contractor, if funds are insufficient to effect complete recovery against dues indicated in (a) above.
c) If contractor fails to deposit the balance amount to be recovered within the period as prescribed in demand notice, following action shall be taken for balance recovery:
   i) Dues payable to contractor against other contracts in the same Region shall be considered for recovery.
   ii) If recovery cannot be made out of dues payable to the contractor as above, balance amount to be recovered, shall be informed to other Regions/Units for making recovery from the Unpaid Bills/Running Bills/SD/BGs/Final Bills of contractor.
   iii) In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against contractor.

15. Clause 2.24 of GCC (Performance Guarantee for Workmanship)

Term "Special Conditions of Contract" appearing in 3rdline of the current clause 2.24.1,is replaced by "Technical Conditions of Contract"

16. Clause 4.2.1.7 of Special Condition of Contract (SCC)

At the end of Clause 4.2.1.7 (i.e. after the line "Decision of BHEL shall be final and binding on the contractor") following para is to be added

"It is not obligatory on the part of BHEL to provide any tools and tackles or other materials other than those specifically agreed to do so by BHEL. However, depending upon the availability, BHEL /BHEL's Customer handling equipment and other plants may be made available to the contractor on payment of hire charges as fixed, subject to the conditions laid down by BHEL/Customer from time to time. Unless paid in advance, such hire charges, if applicable, shall be recovered from contractor's bill / security deposit or any other due payment in one installment."

17. Clause 9.61 of SCC (NON-COMPLIANCE)

Under NON-COMPLIANCE, at the end of Clause 9.61 (i.e. after the line "Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.") following para is to be added:

"In case of any financial deduction made by Customer for lapses of safety other than what is provided above or elsewhere in the contract, the same shall be charged on back-to-back basis on the defaulting contractor without prejudice to any other right spelt anywhere in the tender / contract"

18. Clause 2.15 of GCC (EXTRA WORKS)

Existing Clause 2.15.5 of GCC stands revised as follows:

"After eligibility of extra works is established and finally accepted by BHEL engineer/designer, payment will be released on competent authority's approval at the following rate.

MAN-HOUR RATE FOR ELIGIBLE EXTRA WORKS: Single composite average labour man-hour rate, including overtime if any, supervision, use of tools and tackles and other site expenses and incidentals, consumables for carrying out any major rework/ repairs/ rectification/ modification/ fabrication as certified by site as may arise during the course of erection, testing, commissioning or extra works arising out of transit, storage and erection damages, payment, if found due will be at Rs 108/- per man hour."

19. Clause 9.1 & 9.2 to 9.62 of SCC (HSE & OHSAS Obligations)

| | |
|---|---|
| Cl. no. 9.0 | No change |
| Cl. no. 9.1 | HSE (Health, safety & Environment):<br>Contractor will comply with HSE (Health, safety & Environment) requirements of BHEL as per "HSE Plan for Site Operations by Sub-contractors" (Document no. HSEP:14, Rev.00) attached with this tender. |
| Cl. no. 9.2 to 9.62 | Deleted |

Annexure -B

## Terms & Conditions of Reverse Auction

Against this enquiry for the subject item/ system with detailed scope of supply/service as per tender specifications, BHEL *shall be resorting* to "REVERSE AUCTION PROCEDURE" i.e., ON LINE BIDDING (THROUGH A SERVICE PROVIDER). The philosophy followed for reverse auction shall be English Reverse (No ties).

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
2. *Price bids of all techno-commercially qualified bidders shall be opened and same shall be considered as initial bids of bidders in RA.*
3. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on internet.
4. In case of reverse auction, BHEL will inform the bidders the details of Service Provider to enable them to contact & get trained for participation in the reverse auction.
5. Business rules like event date, time, bid decrement, extension etc. also will be communicated through service provider for compliance.
6. Bidders have to fax /*e-mail* the Compliance form (annexure III) before start of Reverse auction. Without this, the bidder will not be eligible to participate in the event.
7. In line with the NIT terms, BHEL will provide the calculation sheet (e.g., EXCEL sheet) which will help to arrive at "Total Cost to BHEL" which is inclusive of all cost elements in line with terms & conditions of the tender for each of the bidder to enable them to fill-in the price and keep it ready for keying in during the Auction.
8. Reverse auction will be conducted on scheduled date & time.
9. At the end of Reverse Auction event, the lowest bidder value will be known on auction portal.
10. The lowest bidder has to fax/e-mail the duly signed and filled-in prescribed format for price breakup including that of line items, if required, (Annexure IV) as provided on case-to-case basis to Service provider within two working days of Auction without fail.
11. *Bidders shall be required to read the "Terms and Conditions" section of the auctions site of Service provider, using the Login IDs and passwords given to them by the service provider before reverse auction event. Bidders should acquaint themselves of the "Business Rules of Reverse Auction", which will be communicated before the Reverse Auction.*
12. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action *as per extant BHEL guidelines*, shall be initiated by BHEL and the results of the RA scrapped/ aborted.
13. The Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party.
14. *In case of more than four techno commercially qualified bidders, H1 bidder (whose quote is highest in sealed envelope price bid) shall not be allowed to participate in RA. However, there will be no H1 removal in case H1 happens to be MSE or qualifying under PPP-MII, Order 2017 irrespective of the number of bidders qualifying techno-commercially. In case of multiple H1 bidders, all H1 bidders (excluding MSEs and bidders qualifying under PPP-MII, Order 2017) shall be removed provided minimum three bidders remain in fray, else no H1 removal.*

**Annexure -C**

## Certificate by Chartered Accountant on letter head

This is to to Certify that M/S ....., (hereinafter referred to as 'company') having its registered office at ..... is registered under MSMED Act 2006, (Entrepreneur Memorandum No (Part-II) ..... dtd:....., Category:..... (Micro/Small)). (Copy enclosed).

Further verified from the Books of Accounts that the investment of the company as per the latest audited financial year ..... as per MSMED Act 2006 is as follows:

1. **For Manufacturing Enterprises:** Investment in plant and machinery (i.e. original cost **excluding land and building and the items specified by the Ministry of Small Scale Industries vide its** notification No.S.0.1722(E) dated October 5, 2006 :
   Rs.....Lacs
2. **For Service Enterprises:** Investment in equipment (original cost excluding land and building and **furniture, fittings and other items not direCtly related to the service rendered or as may be notified under the MSMED** Act, 2006:
   Rs.....Lacs

3. **For Enterprises (Udyam, registered under Udyam Registration Portal):** Investment in plant and machinery or equipment is Rs.....Lacs and turnover is Rs.....Lacs {as notified in MSME notification no. S.O. 2119 (E) dated 26-06-2020}.

**(Strike off whichever is not applicable)**

The above investment of Rs.....Lacs is within permissible limit of Rs.....Lacs for .....Micro / Small (Strike off which is not applicable) Category under MSMED Act 2006.

Or

The company has been graduated from its original category {Micro/ Small) (Strike off which is not applicable) and the date of graduation of such enterprise from its original category is ..... (dd/mm/yyyy) which is within the period of 3 years from the date of graduation of such enterprise from its original category as notified vide S.O. No. 3322(E) dated 01.11.2013 published in the gazette notification dated 04.11.2013 by Ministry of MSME.

Date:

(Signature)

Name-

Membership number-

Seal of Chartered Accountant

**Annexure –D**

## Specific Clause w.r.t. BOCW Act & Cess Act

1. It shall be the sole responsibility of the contractor as employer to ensure compliance of all the statutory obligations under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder.
2. It shall be sole responsibility of the contractor engaging Building Workers in connection with the building or other construction works in the capacity of employer to apply and obtain registration certificate specifying the scope of work under the relevant provisions of the Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 from the appropriate Authorities.
3. It shall be responsibility of the contractor to furnish a copy of such Registration Certificate within a period of one month from the date of commencement of Work.
4. It is responsibility of the contractor to register under the Building and other Construction Workers' Welfare Cess Act, 1996 and deposit the required Cess for the purposes of the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 at such rate as the Central Government may , by notification in the Official Gazette, from time to time specify. However, before registering and deposit of Cess under the Building and other Construction Workers' Welfare Cess Act, 1996, the contractor will seek written prior approval from the Construction Manager.
5. In case where the contractor has been accorded written approval by the Construction Manager and the contractor is required to furnish information in Form I and deposit the Cess under the Building and other Construction Workers' Welfare Cess Act, 1996, fails to do so, BHEL reserves right to impose penalty at the rate of 30% of Cess Amount.
6. It shall be sole responsibility of the contractor as employer to get registered every Building Worker, who is between the age of 18 to 60 years of age and who has been engaged in any building or other construction work for not less than ninety days during the preceding twelve months as Beneficiary under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996.
7. It shall be sole responsibility of the contractor as employer to maintain all the registers, records, notices and submit returns under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder.
8. It shall be sole responsibility of the contractor as employer to provide notice of poisoning or occupation notifiable diseases, to report of accident and dangerous occurrences to the concerned authorities under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the rules made thereunder and to make payment of all statutory payments & compensation under the Employees' Compensation Act, 1923.
9. It shall be responsibility of the Contractor to furnish BHEL on monthly basis, Receipts/ Challans towards Deposit of the Cess under the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder along with following statistics :
    (i) Number of Building Workers employed during preceding one month.
    (ii) Number of Building workers registered as Beneficiary during preceding one month.
    (iii) Disbursement of Wages made to the Building Workers for preceding wage month.
    (iv) Remittance of Contribution of Beneficiaries made during the preceding month
10. BHEL shall reimburse the contractor the Cess amount deposited for the purposes of the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 under the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder. However, BHEL shall not reimburse the Fee paid towards the registration of establishment, fees paid towards registration of Beneficiaries and Contribution of Beneficiaries remitted.

11. It shall be responsibility of the Building Worker engaged by the Contractor and registered as a beneficiary under the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 to contribute to the Fund at such rate per mensem as may be specified by the State government by notification in the Official Gazette. Where such beneficiary authorizes the contractor being his employer to deduct his contribution from his monthly wages and to remit the same, the contractor shall remit such contribution to the Building and other construction Workers' Welfare Board in such manner as may be directed by the Board , within the fifteen days from such deduction.

12. If any point of time during the contract period, non-compliance of the provisions of the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder is observed, BHEL reserves the right to withhold a reasonable amount from the payables to discharge any obligations on behalf of Contractors. The reasonable amount shall be decided by the Construction Manager in consultation with Resident Accounts Officer & Head HR and shall be final.

13. The contractor shall declare to undertake any liability or claim arising out of employment of building workers and shall indemnify BHEL from all consequences / liabilities / penalties in case of non compliance of the provisions of the Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 and the Building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder.

**ANNEXURE-E**

## Statewise GST Registration nos.

| Sl. No. | State / UT | GST Reg. No. |
|---|---|---|
| 1 | Andhra Pradesh | 37AAACB4146P7Z8 |
| 2 | Assam | 18AAACB4146P1ZE |
| 3 | Bihar | 10AAACB4146P1ZU |
| 4 | Chandigarh | 04AAACB4146P1ZN |
| 5 | Chattishgarh | 22AAACB4146P1ZP |
| 6 | Daman & Diu | 25AAACB4146P1ZJ |
| 7 | Delhi | 07AAACB4146P1ZH |
| 8 | Gujarat | 24AAACB4146P1ZL |
| 9 | Haryana | 06AAACB4146P1ZJ |
| 10 | HP | 02AAACB4146P1ZR |
| 11 | Jharkhand | 20AAACB4146P5ZP |
| 12 | Karnataka | 29AAACB4146P1ZB |
| 13 | Kerala | 32AAACB4146P1ZO |
| 14 | Maharashtra | 27AAACB4146P1ZF |
| 15 | MP | 23AAACB4146P1ZN |
| 16 | Punjab | 03AAACB4146P2ZO |
| 17 | Rajasthan | 08AAACB4146P1ZF |
| 18 | Tamil Nadu | 33AAACB4146P2ZL |
| 19 | Telangana | 36AAACB4146P1ZG |
| 20 | Tripura | 16AAACB4146P1ZI |
| 21 | UP | 09AAACB4146P2ZC |
| 22 | Uttarakhand | 05AAACB4146P1ZL |
| 23 | West Bangal | 19AAACB4146P1ZC |
| 24 | Mizoram | 15AAACB4146P1ZK |
| 25 | Orissa | 21AAACB4146P1ZR |
| 26 | Arunachal Pradesh | 12AAACB4146P1ZQ |

**Annexure- CPP-GST/I**

**Please arrange to submit this filled-up format along with Tender**

| | |
|---|---|
| Name of the Company | |
| Address of Company* | |
| Company Registration Number* | |
| Name of Partners / Directors | |
| | |
| | |
| ALL THE STATES WHERE BIDDER HAS A PLACE OF BUSINESS* | |
| ALL ADDRESS OF VENDOR MENTIONING THEIR PIN AS PER THE LATEST GST REGISTRATION* | |
| GSTN OF ALL THE ABOVE NOTED PLACES OF VENDOR* | |
| | |
| | |
| | |
| | |
| Bidder Type: Indian/ Foreign* | |
| City* | |
| State* | |
| Country* | |
| Postal Code* | |
| PAN/TAN Number* | |
| Company's Establishment Year | |
| Company's Nature of Business* | |
| Company's Legal Status* {limited /undertaking/joint venture/partnership/other} | |
| Company Category* {micro unit as per MSME/small unit as per MSME/medium unit as per MSME/ UAN as per Udyog Aadhaar Memorandum/ Ancillary unit/project affected person of this company/ssi/ other}<br><br>Relevant documents to be submitted as applicable. | |
| Enter Company's Contact Person Details | |
| Title(Mr. / Mrs. / Ms. / Dr. / Shri)* | |
| Contact Name* | |
| Date Of Birth* | |
| Correspondence Email* | |
| (Correspondence Email ID can be same | |
| as your Login ID. All the mail correspondence | |
| will be sent only to the Correspondence Email ID.) | |
| Designation | |
| Phone* | |
| Fax* | |
| Mobile* | |

Form-2 (Format for local content)

Format for Certification regarding Local content (LC) for Services or Works
[Certificate to be provided by local supplier from the Statutory Auditor or Cost Auditor of the company (in the case of companies) or from a practicing Cost Accountant or practicing Chartered Accountant (in respect of local suppliers other than companies)

Date:

I < name of Statutory Auditor/Cost Auditor/ practicing Cost Accountant/practicing Chartered Accountant > do hereby certify that < name of authorized signatory of bidder > S/o, D/o, W/o _____, Resident of _____ has solemnly affirmed and declared as under:

That the percentage of local content for the product/service offered by the bidder/supplier against the subject tender is _____%.

That he/she agreed to abide by terms and conditions of Department of Industrial Policy & Promotion issued vide Notification No: P-45021/2/2017-B.E.-II Dated: 15-06-2017 & P-45021/2/2017-PP (BE-II) Dated: 28-05-2018, of Department of Promotion of Industry and Internal Trade issued vide Notification No: P-45021/2/2017-PP(BE-II) Dated: 29-05-2019 & P-45021/2/2017-PP (BE-II) Dated: 04-06-2020.

That the information furnished hereinafter by him/her is correct to best of my knowledge and belief and I undertake to produce relevant records before the procuring entity or any other authority so nominated by the Government of India for the purpose of assessing the LC.

That the LC for all inputs which constitute the said Product/Services/Works has been verified by me and I am responsible for the correctness of the claims made therein.

That in the event of the LC of the Product/ Services/ Works mentioned herein is found to be incorrect and not meeting the prescribed LC norms, based on the assessment of an authority so nominated by the Government of India and he/she will be liable as under clause 9 (f) of Public Procurement (Preference to Make in India) order 2017.

He/she agrees to maintain all information regarding his/her claim for LC in the Company's record for a period of 2 years and shall make this available for verification to any statutory authorities

i. Name and details of the Local supplier (registered Office, Manufacturing and location, nature of legal entity)
ii. Date on which this certificate is issued
iii. Product / Services/ Works for which the certificate is produced
iv. Procuring agency to whom the certificate is furnished
v. Percentage of LC claimed.
vi. Name and contract details of the unit of the manufacturer
vii. Sale Price of the product
viii. Ex-Factory Price of the product
ix. Freight, insurance and handling
x. Total Bill of Material
xi. List and total cost value of inputs used for manufacture of the Products/ Services/Works
xii. List and total cost of inputs which are locally sourced. Please attach LC certificates from local suppliers, if the input is not in-house.
xiii. List and cost of inputs which are imported, directly or indirectly

For and behalf of _____ <Name of Statutory Auditor/Cost Auditor/ practicing Cost Accountant/practicing Chartered Accountant>

Stamped & signed by Authorized signatory
<Insert Name, Designation and Contract No and date>

# INTEGRITY PACT

**Between**

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi - 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

**and**

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

## Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for _____ _____ _____ . The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

## Section 1- Commitments of the Principal

1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions:

## Section 2 - Commitments of the Bidder(s)/ Contractor(s)

2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and will await their decision in the matter.

## Section 3 - Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

## Section 4 - Compensation for Damages

4.1 If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent Earnest Money Deposit/ Bid Security.

4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to

demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee, whichever is higher.

**Section 5 - Previous Transgression**

5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.

5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

**Section 6 - Equal treatment of all Bidders/ Contractors / Sub-contractors**

6.1 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors. In case of sub-contracting, the Principal contractor shall be responsible for the adoption of IP by his sub-contractors and shall continue to remain responsible for any default by his sub-contractors.

6.2 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

**Section 7 - Criminal Charges against violating Bidders/ Contractors /Subcontractors**

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

**Section 8 - Independent External Monitor(s)**

8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.

8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality in line with Non- disclosure agreement.

8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

8.5 The role of IEMs is advisory, would not be legally binding and it is restricted to resolving issues raised by an intending bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.

8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process, the matter should be examined by the full panel of IEMs jointly as far as possible, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.

8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to CMD, BHEL, at the earliest. They may also send their report directly to the CVO and the Commission, in case of suspicion of serious irregularities requiring legal/ administrative action. IEMs will tender their advice on the complaints within 10 days as far as possible.

8.8 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.

8.9 IEM should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the organization should be looked into by the CVO of the concerned organisation.

8.10 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code/ Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.11 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.

8.12 The word 'Monitor' would include both singular and plural.

## Section 9 - Pact Duration

9.1 This Pact shall be operative from the date IP is signed by both the parties till the final completion of contract for successful bidder and for all other bidders 6 months after the contract has been awarded. Issues like warranty / guarantee etc. should be outside the purview of IEMs.

9.2 If any claim is made/ lodged during currency of IP, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

## Section 10 - Other Provisions

10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.

10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders / contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

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For & On behalf of the Principal

(Office Seal)

---

For & On behalf of the Bidder/ Contractor

(Office Seal)

Place----------

Date----------

Witness:_____

(Name & Address) _____

_____

Witness:_____

(Name & Address) _____

_____



सुब्रत सेन / Subrata Sen
महाप्रबंधक (उप संविदा) / Addl. General Manager (Sub Contract)
बी. एच. ई. एल. / पी.एस.ई.आर / BHEL / PSER
डी जे - 9/1, सॉल्ट लेक / DJ-9/1, SALT LAKE
कोलकाता-700 091 / KOLKATA-700 091

**TENDER NO: PSER:SCT:NBN-C2067:20**

**VOLUME -IB**

# GENERAL CONDITIONS OF CONTRACT

(SERVICE)

**FOR**

CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.


## BHARAT HEAVY ELECTRICALS LIMITED

**( A GOVT. OF INDIA UNDERTAKING )**
**POWER SECTOR – EASTERN REGION**
**PLOT NO. – 9 / 1, DJ – BLOCK,**
**SECTOR – II, KARUNAMOYEE,**
**SALT LAKE CITY,**
**KOLKATA – 700091.**

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# CHAPTER -1

## 1. GENERAL INSTRUCTION TO TENDERERS

### 1.1. DESPATCH INSTRUCTION

i) The General Conditions of Contract form part of the Tender specifications. All pages of the tender documents shall be duly signed, stamped and submitted along with the offer in token of complete acceptance thereof. The information furnished shall be complete by itself. The tenderer is required to furnish all the details and other documents as required in the following pages

ii) Tenderers are advised to study all the tender documents carefully. Any submission of tender by the tenderer shall be deemed to have been done after careful study and examination of the tender documents and with the full understanding of the implications thereof. Should the tenderers have any doubt about the meaning of any portion of the Tender Specification or find discrepancies or omissions in the drawings or the tender documents issued are incomplete or shall require clarification on any of the technical aspect, the scope of work etc., he shall at once, contact the authority inviting the tender well in time (so as not to affect last date of submission) for clarification before the submission of the tender. Tenderer's request for clarifications shall be with reference to Sections and Clause numbers given in the tender documents. The specifications and terms and conditions shall be deemed to have been accepted by the tenderer in his offer. Non compliance with any of the requirements and instructions of the tender enquiry may result in the rejection of the tender.

iii) Integrity pact (IP) shall be applicable for all tenders / contracts if indicated in NIT. This integrity pact shall be issued as part of the Tender documents and shall be returned by the bidder along with Techno-commercial bid duly filled, signed and stamped by the authorized signatory who signs the bid. Only those vendors / bidders who have entered into such an IP with BHEL shall be considered qualified to participate in the bidding. Entering into this pact shall be a preliminary qualification.

### 1.2. SUBMISSION OF TENDERS

1.2.1 The tenderers must submit their tenders to Officer inviting tender as per instructions in the NIT

1.2.2 Tenders submitted by post shall be sent by 'REGISTERED POST ACKNOWLEDGEMENT DUE / by COURIER' and shall be posted with due allowance for any postal/courier delays. BHEL takes no responsibility for delay, loss or non-receipt of tenders sent by post/courier. The tenders received after the specified time of their submission are treated as 'Late Tenders' and shall not be considered under any circumstances. Offers received by Fax/Email/Internet shall be considered as per terms of NIT.

1.2.3 Tenders shall be opened by authorised Officer of BHEL at his office at the time and date as specified in the NIT, in the presence of such of those tenderers or their authorised representatives who may be present

1.2.4 Tenderers whose bids are found techno commercially qualified shall be informed the date and time of opening of the Price Bids and such Tenderers may depute their representatives to witness the opening of the price bids. BHEL's decision in this regard shall be final and binding.

1.2.5 Before submission of Offer, the tenderers are advised to inspect the site of work and the environments and be well acquainted with the actual working and other prevalent conditions, facilities available, position of material and labour, means of transport and access to Site, accommodation, etc. No claim will be entertained later on the grounds of lack of knowledge of any of these conditions.

1.3. LANGUAGE

1.3.1 The tenderer shall quote the rates in English language and international numerals. These rates shall be entered in figures as well as in words. For the purpose of the tenders, the metric system of units shall be used.

1.3.2 All entries in the tender shall either be typed or written legibly in ink. Erasing and over-writing is not permitted and may render such tenders liable for rejection. All cancellations and insertions shall be duly attested by the tenderer.

1.4 PRICE DISCREPANCY:

1.4.1 Conventional (Manual) Price Bid opening : In the case of price bid opening without resorting to Reverse Auction, if there are differences between the rates given by the tenderer in words and figures or in amount worked out by him, the following procedure for evaluation and award shall be followed:

i) When there is a difference between the rates in figures and in words, the rates which corresponds to the amounts worked out by the contractor, shall be taken as correct

ii) When the amount of an item is not worked out by the contractor or it does not correspond with the rate written either in figure or in words, then the rate quoted by the contractor in words shall be taken as correct

iii) When the rate quoted by the contractor in figures and words tallies but the amount is not worked out correctly, the rate quoted by the contractor shall be taken as correct and not the amount.

iv) In case of lumpsum price, if there is any difference between the amount in figures and in words, the amount quoted by the bidder in words shall be taken as correct.

v) In case of omission in quoting any rate for one or more items, the evaluation shall be done considering the highest quoted rate obtained against the respective items by other tenderers for the subject tender. If the tenderer becomes L-1, the notional rates for the omission items shall be the lowest rates quoted for the respective items by the other tenderers against the respective omission items for the subject job and the 'Total quoted price (loaded for omissions)' shall be arrived at. However the overall price remaining the same as quoted originally, the rates for all the items in the 'Total quoted price (loaded for omissions)' shall be reduced item wise in proportion to the ratio of 'Original' total price and the 'Total quoted price (loaded for omissions)''.

vi) The 'Final Total Amount' shall be arrived at after considering the amounts worked out in line with 'i' to 'iv' above.

1.4.2 Reverse Auction: In case of Reverse Auction, the successful bidder shall undertake to execute

the work as per overall price offered by him during the Reverse Auction process. In case of omission of rates, the procedure shall be as per 'Guidelines for Reverse Auction' enclosed.

1.5. QUALIFICATION OF TENDERERS

i) Only tenderers who have previous experience in the work of the nature and description detailed in the Notice Inviting Tender and/or tender specification are expected to quote for this work duly detailing their experience along with offer.

ii) Offers from tenderers who do not have proven and established experience in the field shall not be considered

iii) .Offers from tenderers who are under suspension (banned) by any Unit/Region/Division of BHEL shall not be considered.

iv) Offers from tenderers who do not comply with the latest guidelines of Ministry/Commissions of Govt of India shall not be considered.

1.6. EVALUATION OF BIDS

i) Technical Bids submitted by the tenderer will be opened first and evaluated for fulfilling the Pre Qualification criteria and other conditions in NIT/Tender documents, based on documentary evidences submitted along with the offer

ii) In case the same qualifying experience is claimed by more than one agency, then the agency who has executed the work as per documentary evidence submitted shall only be qualified. Scope of qualifying work should be totally with the agency who has executed and in case it is only labour+consumables without T&P, then the responsibility of execution is assigned to the first agency and not to the agency who has executed only as labour supply contractor. Further, BHEL reserves the right to ask for further proofs including submission of TDS certificates for the said job

iii) In case the qualifying experience is claimed by private organizations based on Work Order and completion certificates from another private organization, BHEL reserves the right to ask for further proofs including submission of TDS certificates for the said job

iv) Assessing Bidder Capacity for executing the current tender shall be as per Notice Inviting Tender

v) Price Bids of shortlisted bidders shall only be opened either through the conventional price bid opening or through electronic Reverse Auction, at the discretion of BHEL

vi) Price Bids of unqualified bidders shall not be opened. Reasons for rejection shall be intimated in due course after issue of LOI/LOA to successful bidder and receipt of unqualified acceptance from the successful bidder

vii) Bidders are advised to also refer to clause no 2.9.4 regarding evaluation of their performance in ongoing projects for the current tender

1.7. DATA TO BE ENCLOSED

Full information shall be given by the tenderer in respect of the following. Non-submission of this information may lead to rejection of the offer.

i) INCOME TAX PERMANENT ACCOUNT NUMBER

Certified copies of Permanent Account Numbers as allotted by Income Tax Department for the Company/Firm/Individual Partners, etc. shall be furnished along with tender.

ii) ORGANIZATION CHART

The organization chart of the tenderer's organization, including the names, addresses and contact

information of the Directors/Partners shall be furnished along with the offer.

iii) An attested copy of the Power of Attorney, in case the tender is signed by an individual other than the sole proprietor

iv) IN CASE OF INDIVIDUAL TENDERER:
His / her full name, address and place & nature of business.

v) IN CASE OF PARTNERSHIP FIRM
The names of all the partners and their addresses, A copy of the partnership deed/instrument of partnership dully certified by the Notary Public shall be enclosed.

vi) IN CASE OF COMPANIES:

a. Date and place of registration including date of commencement certificate in case of Public Companies (certified copies of Memorandum and articles of Association are also to be furnished).
b. Nature of business carried on by the Company and the provisions of the Memorandum relating thereof.

1.8 AUTHORISATION AND ATTESTATION
Tenders shall be signed by a person duly authorized/empowered to do so. An attested copy of the Power of Attorney, in case the tender is signed by an individual other than the sole proprietor shall be submitted along with the tenders

1.9 EARNEST MONEY DEPOSIT

1.9.1 Every tender must be accompanied by the prescribed amount of Earnest Money Deposit (EMD) in the manner described herein.

i) EMD shall be furnished along with the offer in full as per the amount indicated in the Special Conditions of Contract / NIT
ii) EMD is to be paid in cash (as permissible under Income Tax Act), Pay order or Demand Draft in favour of 'Bharat Heavy Electricals Limited' and payable at Regional HQ issuing the tender.
iii) No other form of EMD remittance shall be acceptable to BHEL
iv) Bidder may opt to deposit "One Time EMD" of Rs. 2.0 lakhs (Rupees Two lakhs only) with BHEL:Power Sector Region HQ issuing the tender, which will enable them to participate in all the future tender enquiries in respect of Erection and Commissioning services issued from the respective office. Interested bidders may clearly send their consent for converting the present EMD into a "One Time EMD" in their offer.
   - Note : The 'One Time EMD' cannot be withdrawn by the tenderers within 3 years from the date of deposit, under any circumstances. The Tenderer who wishes to withdraw after three years will not be allowed to submit 'One Time EMD' again.
v) Bidders who have already deposited such "One Time EMD" of Rs. 2.00 lakh are exempted from submission of EMD for this tender. However a copy of 'One Time EMD' certificate issued by BHEL Regional HQ issuing the tender shall be enclosed along with the offer.

1.9.2 EMD by the bidder will be forfeited as per Tender Documents if

i) After opening the tender, the bidder revokes his tender within the validity period or increases his

earlier quoted rates.

ii) The bidder does not commence the work within the period as per LOI/Contract. In case the LOI / contract is silent in this regard then within 15 days after award of contract.

1.9.3 EMD shall not carry any interest.

1.9.4 In the case of unsuccessful bidders, the Earnest Money will be refunded to them within a reasonable time after acceptance of award by successful tenderer.

1.10 SECURITY DEPOSIT

1.10.1 Upon acceptance of Tender, the successful Tenderer should deposit the required amount of Security Deposit for satisfactory completion of work, as per the rates given below:

| SN | Contract Value | Security Deposit Amount |
|---|---|---|
| 1 | Up to Rs. 10 lakhs | 10% of Contract Value |
| 2 | Above Rs. 10 lakhs upto Rs.50 lakhs | 1 lakh + 7.5% of the Contract Value exceeding Rs. 10 lakhs. |
| 3 | Above Rs. 50 lakhs | Rs 4 lakhs + 5% of the Contract Value exceeding Rs. 50 lakhs. |

1.10.2 The security Deposit should be furnished before start of the work by the contractor.

1.10.3 Security Deposit may be furnished in any one of the following forms

i) Cash (as permissible under the Income Tax Act)
ii) Pay Order / Demand Draft in favour of BHEL.
iii) Local cheques of scheduled banks, subject to realization.
iv) Securities available from Post Offices such as National Savings Certificates, Kisan Vikas Patras etc. (Certificates should be held in the name of Contractor furnishing the security and duly pledged in favour of BHEL and discharged on the back).
v) Bank Guarantee from Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format for Security Deposit shall be in the prescribed formats
vi) Fixed Deposit Receipt issued by Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The FDR should be in the name of the contractor, A/C BHEL, duly discharged on the back.
vii) Security deposit can also be recovered at the rate of 10% from the running bills. However in such cases at least 50% of the Security Deposit should be deposited in any form as prescribed before start of the work and the balance 50% may be recovered from the running bills.
viii) EMD of the successful bidder can be converted and adjusted against the cash portion of Security Deposit excepting for such bidders who have remitted One Time EMD.

NOTE: Acceptance of Security Deposit against Sl. No. (iv) and (vi) above will be subject to hypothecation or endorsement on the documents in favour of BHEL. However, BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith.

1.10.4 The Security Deposit shall not carry any interest.

1.10.5 In case the value of work exceeds / reduces from the awarded / accepted value, the Security Deposit shall be correspondingly enhanced / reduced as given below:

i) The enhanced part of the Security Deposit shall be immediately deposited by the Contractor or adjusted against payments due to the Contractor.

ii) There will be no reduction in Security Deposit value in case of variation in contract value upto the lower limit specified in Quantity variation clause. In case of reduction of contract value beyond the lower limit specified in Quantity Variation clause, then the Security Deposit shall be re adjusted in proportion.

iii) In case of reduction, the reduced Contract value shall be certified by BHEL Construction Manager after ascertaining / freezing of BOQ / Drawings from the Design / Engineering Centre. The reduced Security Deposit value can only be considered after taking into account the adequacy of the securities held by BHEL to meet the liabilities of the contractor for the contract, and the performance of the contract in general. In such cases, the revised value of Security Deposit shall be worked out only after execution of not less than the lower limit of the revised scope of work/contract value as per quantity variation clause, and as certified by Construction Manager. This reduction in value of Security Deposit shall not entitle the contractor to any amendment of Contract and shall be operated at the discretion of BHEL

iv) Contract value for the purpose of operating the reduced/increased value of Security Deposit due to Quantity Variation, shall be exclusive of Price Variation Clause, Over Run Compensation and Extra works done on manday rates.

1.10.6 The validity of Bank Guarantees towards Security Deposit shall be initially upto the completion period as stipulated in the Letter of Intent/Award + 3 months, and the same shall be kept valid by proper renewal till the acceptance of Final Bills of the Contractor, by BHEL

1.10.7 BHEL reserves the right of forfeiture of Security Deposit in addition to other claims and penalties in the event of the Contractor's failure to fulfill any of the contractual obligations or in the event of termination of contract as per terms and conditions of contract. BHEL reserves the right to set off the Security Deposit against any claims of other contracts with BHEL.

1.11 RETURN OF SECURITY DEPOSIT

Security Deposit shall be refunded/Bank Guarantee(s) released to the Contractor along with the 'Final Bill' after deducting all expenses / other amounts due to BHEL under the contract / other contracts entered into with them by BHEL.

1.12 BANK GUARANTEES

Where ever Bank Guarantees are to be furnished/submitted by the contractor, the following shall be complied with

i) Bank Guarantees shall be from Scheduled Banks / Public Financial Institutions as defined in the Companies Act.

ii) The Bank Guarantees shall be as per prescribed formats.

iii) It is the responsibility of the bidder to get the Bank Guarantees revalidated/extended for the required period (subject to a minimum period of six months), as per the advice of BHEL Site Engineer / Construction Manager. BHEL shall not be liable for issue of any reminders regarding expiry of the

Bank Guarantees.

iv) In case extension/further extensions of any Bank Guarantees are not required, the bidders shall ensure that the same is explicitly endorsed by the Construction Manager and submitted to the Regional HQ issuing the LOI/LOA.

v) In case the Bank Guarantees are not extended before the expiry date, BHEL reserves the right to invoke the same by informing the concerned Bank in writing, without any advance notice/communication to the concerned bidder.

vi) Bidders to note that any corrections to Bank Guarantees shall be done by the issuing Bank, only through an amendment in an appropriate non judicial stamp paper.

vii) The Original Bank Guarantee shall be sent directly by the Bank to BHEL under Registered Post (Acknowledgement Due), addressed to the Subcontracting Department of the respective Region.

1.13 VALIDITY OF OFFER

The rates in the Tender shall be kept open for acceptance for a minimum period of SIX MONTHS from latest due date of offer submission (including extension, if any) . In case BHEL (Bharat Heavy Electricals Ltd) calls for negotiations, such negotiations shall not amount to cancellation or withdrawal of the original offer which shall be binding on the tenderers.

1.14 EXECUTION OF CONTRACT AGREEMENT

The successful tenderer's responsibility under this contract commences from the date of issue of the Letter of Intent by Bharat Heavy Electricals Limited. The Tenderer shall submit an unqualified acceptance to the Letter of Intent/Award within the period stipulated therein.

The successful tenderer shall be required to execute an agreement in the prescribed form, with BHEL, within a reasonable time after the acceptance of the Letter of Intent/Award, and in any case before releasing the first running bill. The contract agreement shall be signed by a person duly authorized/empowered by the tenderer. The expenses for preparation of agreement document shall be borne by BHEL

1.15 REJECTION OF TENDER AND OTHER CONDITIONS

1.15.1 The acceptance of tender will rest with BHEL which does not bind itself to accept the lowest tender or any tender and reserves to itself full rights for the following without assigning any reasons whatsoever:-

a. To reject any or all of the tenders.

b. To split up the work amongst two or more tenderers as per NIT

c. To award the work in part if specified in NIT

d. In case of either of the contingencies stated in (b) and (c) above, the time for completion as stipulated in the tender shall be applicable.

1.15.2 Conditional tenders, unsolicited tenders, tenders which are incomplete or not in the form specified or defective or have been materially altered or not in accordance with the tender

conditions, specifications etc., are liable to be rejected.

1.15.3 Tenders are liable to be rejected in case of unsatisfactory performance of the tenderer with BHEL, or tenderer under suspension (hold/banning /delisted ) by any unit / region / division of BHEL or tenderers who do not comply with the latest guidelines of Ministry/Commissions of Govt of India. BHEL reserves the right to reject a bidder in case it is observed that they are overloaded and may not be in a position to execute this job as per the required schedule in line with clause no. 9.0 of the 'NIT'. The decision of BHEL will be final in this regard.

1.15.4 If a tenderer who is a proprietor expires after the submission of his tender or after the acceptance of his tender, BHEL may at their discretion, cancel such tender. If a partner of a firm expires after the submission of tender or after the acceptance of the tender, BHEL may then cancel such tender at their discretion, unless the firm retains its character.

1.15.5 BHEL will not be bound by any Power of Attorney granted by changes in the composition of the firm made subsequent to the execution of the contract. They may, however, recognise such power of Attorney and changes after obtaining proper legal advice, the cost of which will be chargeable to the contractor concerned.

1.15.6 If the tenderer deliberately gives wrong information in his tender, BHEL reserves the right to reject such tender at any stage or to cancel the contract if awarded and forfeit the Earnest Money/Security Deposit/any other money due.

1.15.7 Canvassing in any form in connection with the tenders submitted by the Tenderer shall make his offer liable to rejection.

1.15.8 In case the Proprietor, Partner or Director of the Company/Firm submitting the Tender, has any relative or relation employed in BHEL, the authority inviting the Tender shall be informed of the fact as per specified format, along with the Offer. Failing to do so, BHEL may, at its sole discretion, reject the tender or cancel the contract and forfeit the Earnest Money/Security Deposit.

1.15.9 The successful tenderer should not sub-contract part or complete work detailed in the tender specification undertaken by him without written permission of BHEL's Construction Manager/Site Incharge. The tenderer is solely responsible to BHEL for the work awarded to him.

1.15.10 The Tender submitted by a techno commercially qualified tenderer shall become the property of BHEL who shall be under no obligation to return the same to the bidder. However unopened price bids and late tenders shall be returned to the bidders

1.15.11 Unsolicited discount received after the due date and time of Bid Submission shall not be considered for evaluation. However, if the party who has submitted the unsolicited discount/rebate becomes the L-I party, then the awarded price i.e contract value shall be worked out after considering the discount so offered.

1.15.12 BHEL shall not be liable for any expenses incurred by the bidder in the preparation of the tender irrespective of whether the tender is accepted or not.

# CHAPTER-2

2.1 DEFINITION: The following terms shall have the meaning hereby assigned to them except where the context otherwise requires

i) BHEL shall mean Bharat Heavy Electricals Limited (of the respective Power Sector Region inviting the Tender), a company registered under Indian Companies Act 1956, with its Registered Office at BHEL HOUSE, SIRI FORT, NEW DELHI – 110 049, or its Power Sector Regional Offices or its Authorised Officers or its Site Engineers or other employees authorised to deal with any matters with which these persons are concerned on its behalf.

ii) "EXECUTIVE DIRECTOR" or 'GROUP GENERAL MANAGER' or "GENERAL MANAGER (Incharge)" or "GENERAL MANAGER" shall mean the Officer in Administrative charge of the respective Power Sector Region.

iii) "COMPETENT AUTHORITY" shall mean Executive Director or Group General Manager or General Manager (Incharge) or General Manager or BHEL Officers who are empowered to act on behalf of the Executive Director or General Manager (Incharge) or General Manager of BHEL.

iv) "ENGINEER" or "ENGINEER IN CHARGE" shall mean an Officer of BHEL as may be duly appointed and authorized by BHEL to act as "Engineer" on his behalf for the purpose of the Contract, to perform the duty set forth in this General Conditions of Contract and other Contract documents. The term also includes 'CONSTRUCTION MANAGER' or 'SITE INCHARGE' as well as Officers at Site or at the Headquarters of the respective Power Sector Regions.

v) "SITE" shall mean the places or place at which the plants/equipments are to be erected and services are to be performed as per the specification of this Tender.

vi) "CLIENT OF BHEL" or "CUSTOMER" shall mean the project authorities with whom BHEL has entered into a contract for supply of equipments or provision of services.

vii) "CONTRACTOR" shall mean the successful Bidder/Tenderer who is awarded the Contract and shall include the Contractor's successors, heirs, executors, administrators and permitted assigns.

viii) "CONTRACT" or "CONTRACT DOCUMENT" shall mean and include the Agreement of Work Order, the accepted appendices of Rates, Schedules, Quantities if any, General Conditions of Contract, Special Conditions of Contract, Instructions to the Tenderers, Drawings, Technical Specifications, the Special Specifications if any, the Tender documents, subsequent amendments mutually agreed upon and the Letter of Intent/Acceptance issued by BHEL. Any conditions or terms stipulated by the contractor in the tender documents or subsequent letters shall not form part of the contract unless, specifically accepted in writing by BHEL in the Letter of Intent/Award and incorporated in the agreement.

ix) "GENERAL CONDITIONS OF CONTRACT" shall mean the 'Instructions to Tenderers' and 'General Conditions of Contract' pertaining to the work for which above tenders have been called for.

| | |
|---|---|
| x) | "TENDER SPECIFICATION" or "TENDER" or "TENDER DOCUMENTS" shall mean General Conditions, Common Conditions, Special Conditions, Price Bid, Rate Schedule, Technical Specifications, Appendices, Annexures, Corrigendums, Amendments, Forms, procedures, Site information, etc and drawings/documents pertaining to the work for which the tenderers are required to submit their offers. Individual specification number will be assigned to each Tender Specification. |
| xi) | "LETTER OF INTENT" shall mean the intimation by a Letter/Fax/email to the tenderer that the tender has been accepted in accordance with provisions contained in the letter. The responsibility of the contractor commences from the date of issue of this letter and all terms and conditions of the contract are applicable from this date. |
| xii) | "COMPLETION TIME" shall mean the period by 'date/month' specified in the 'Letter of Intent/Award' or date mutually agreed upon for handing over of the intended scope of work, the erected equipment/plant which are found acceptable by the Engineer, being of required standard and conforming to the specifications of the Contract. |
| xiii) | "PLANT" shall mean and connote the entire assembly of the plant and equipments covered by the contract. |
| xiv) | "EQUIPMENT" shall mean equipment, machineries, materials, structural, electricals and other components of the plant covered by the contract. |
| xv) | "TESTS" shall mean and include such test or tests to be carried out on the part of the contractor as are prescribed in the contract or considered necessary by BHEL, in order to ascertain the quality, workmanship, performance and efficiency of the contractor or part thereof. |
| xvi) | "APPROVED", "DIRECTED" or "INSTRUCTED" shall mean approved, directed or instructed by BHEL. |
| xvii) | "WORK or CONTRACT WORK" shall mean and include supply of all categories of labour, specified consumables, tools and tackles and Plants required for complete and satisfactory site transportation, handling, stacking, storing, erecting, testing and commissioning of the equipments to the entire satisfaction of BHEL. |
| xviii) | "SINGULAR AND PLURALS ETC" words carrying singular number shall also include plural and vice versa, where the context so requires. Words imparting the masculine Gender shall be taken to include the feminine Gender and words imparting persons shall include any Company or Associations or Body of Individuals, whether incorporated or not. |
| xix) | "HEADING" – The heading in these General Conditions are solely for the purpose of facilitating reference and shall not be deemed to be part thereof or be taken as instructions thereof or of the contract. |
| xx) | "MONTH" shall mean calendar month unless otherwise specified in the Tender. |

xxi) Day' or 'Days' unless herein otherwise expressly defined shall mean calendar day or days of twenty four (24) hours each. A week shall mean continuous period of seven (7) days.

xxii) "COMMISSIONING" shall mean the synchronisation testing and achieving functional operation of the Equipment with associated system after all initial adjustments, trials, cleaning, re-assembly required at site if any, have been completed and Equipment with associated system is ready for taking into service.

xxiii) "WRITING" shall include any manuscript type written or hand written or printed statement or electronically transmitted messages, under the signature or seal or transmittal of BHEL.

xxiv) "TEMPORARY WORK" shall mean all temporary works for every kind required in or for the execution, completion, maintenance of the work.

xxv) 'CONTRACT PRICE' or 'CONTRACT VALUE' shall mean the sum mentioned in the LOI/LOA/Contract Agreement subject to such additions thereto or deductions there from as may be made under provisions hereinafter contained

xxvi) "COMMENCEMENT DATE" or "START DATE" shall mean the commencement/start of work at Site as per terms defined in the Tenderl

xxvii) "SHORT CLOSING" or "FORE CLOSING" of Contract shall mean the premature closing of Contract, for reasons not attributable to the contractor and mutually agreed between BHEL and the contractor

xxviii) "TERMINATION" of Contract shall mean the pre mature closing of contract due to reasons as mentioned in the contract

xxix) "DE MOBILISATION" shall mean the temporary winding up of Site establishment by Contractor leading to suspension of works temporarily for reasons not attributable to the contractor

xxx) "RE MOBILISATION" shall mean the resumption of work with all resources required for the work after demobilization.

2.2 LAW GOVERNING THE CONTRACT AND COURT JURISDICTION

The contract shall be governed by the Law for the time being in force in the Republic of India. The Civil Court having original Civil Jurisdiction at Delhi for PSNR, at Kolkata for PSER, at Nagpur for PSWR and at Chennai for PSSR, shall alone have exclusive jurisdiction in regard to all claims in respect of the Contract. No other Civil Court shall have jurisdiction in case of any dispute, under this contract

2.3 ISSUE OF NOTICE

2.3.1 Service of notice on contractor

Any notice to be given to the Contractor under the terms of the contract shall be served by sending the same by Registered Post / Speed Post to or leaving the same at the Contractor's last known address of the principal place of business (or in the event of the contractor being a company, to or at its Registered Office). In case of change of address, the notice shall be served at changed address as notified in writing by the Contractor to BHEL. Such posting or leaving of the notice shall be deemed to be good service of such notice and the time mentioned to the condition for doing any act after notice shall be reckoned from the date so mentioned in such notice.

2.3.2 Service of notice on BHEL

Any notice to be given to BHEL in-charge/Region under the terms of the Contract shall be served by sending the same by post to or leaving the same at BHEL address or changed address as notified in writing by BHEL to the Contractor.

2.4 USE OF LAND

No land belonging to BHEL or their Customer under temporary possession of BHEL shall be occupied by the contractor without written permission of BHEL.

2.5 COMMENCEMENT OF WORK

2.5.1 The contractor shall commence the work as per the time indicated in the Letter of Intent from BHEL and shall proceed with the same with due expedition without delay.

2.5.2 If the contractor fails to start the work within stipulated time as per LOI or as intimated by BHEL, then BHEL at its sole discretion will have the right to cancel the contract. The Earnest Money and/or Security Deposit with BHEL will stand forfeited without any further reference to him without prejudice to any and all of BHEL's other rights and remedies in this regard.

2.5.3 All the work shall be carried out under the direction and to the satisfaction of BHEL.

2.6 MEASUREMENT OF WORK AND MODE OF PAYMENT:

2.6.1 All payments due to the contractors shall be made by e mode only, unless otherwise found operationally difficult for reasons to be recorded in writing
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2.6.2 For progress running bill payments: - The Contractor shall present detailed measurement sheets in triplicate, duly indicating all relevant details based on technical documents and connected drawings for work done during the month/period under various categories in line with terms of payment as per contract. The basis of arriving at the quantities, weights shall be relevant documents and drawings released by BHEL. These measurement sheets shall be prepared jointly with BHEL Engineers and signed by both the parties.

2.6.3 These measurement sheets will be checked by BHEL Engineer and quantities and percentage eligible for payment under various groups shall be decided by BHEL Engineer. The abstract of quantities and percentage so arrived at based on the terms of payment shall be entered in Measurement Book and signed by both the parties.

2.6.4 Based on the above quantities, contractor shall prepare the bills in prescribed format and work out the financial value. These will be entered in Measurement Book and signed by both the parties. Payment shall be made by BHEL after effecting the recoveries due from the contractor.

2.6.5 All recoveries due from the contractor for the month/period shall be effected in full from the corresponding running bills unless specific approval from the competent authorities is obtained to the contrary.

2.6.6 Measurement shall be restricted to that portion of work for which it is required to ascertain the financial liability of BHEL under this contract.

2.6.7 The measurement shall be taken jointly by persons duly authorized on the part of BHEL and by the Contractor.

2.6.8 The Contractor shall bear the expenditure involved if any, in making the measurements and testing of materials to be used/used in the work. The contractor shall, without extra charges, provide all the assistance with appliances and other things necessary for measurement.

2.6.9 If at any time due to any reason whatsoever, it becomes necessary to re-measure the work done in full or in part, the expenses towards such re measurements shall be borne by the contractor unless such re measurements are warranted solely for reasons not attributable to contractor.

2.6.10 Passing of bills covered by such measurements does not amount to acceptance of the completion of the work measured. Any left out work has to be completed, if pointed out at a later date by BHEL.

2.6.11 Final measurement bill shall be prepared in the final bill format prescribed for the purpose based on the certificate issued by BHEL Engineer that entire works as stipulated in tender specification has been completed in all respects to the entire satisfaction of BHEL. Contractor shall give unqualified "No Claim" Certificate. All the tools and tackles loaned to him should be returned in satisfactory condition to BHEL. The abstract of final quantities and financial values shall also be entered in the Measurement Books and signed by both parties to the contract. The Final Bill shall be prepared and paid within a reasonable time after completion of work.

2.7 RIGHTS OF BHEL

BHEL reserves the following rights in respect of this contract during the original contract period or its extensions if any, as per the provisions of the contract, without entitling the contractor for any compensation.

2.7.1 To withdraw any portion of work and/or to restrict/alter quantum of work as indicated in the contract during the progress of work and get it done through other agencies to suit BHEL's commitment to its customer or in case BHEL decides to advance the date of completion due to other emergent reasons/ BHEL's obligation to its customer.

2.7.2 To terminate the contract or get any part of the work done through other agency or deploy BHEL's own/hired/otherwise arranged resources , at the risk and cost of the contractor after due notice <u>of a period of two weeks by BHEL,</u> in the event of:-

i) Contractor's continued poor progress
ii) Withdrawal from or abandonment of the work before completion of the work
iii) Contractor's inability to progress the work for completion as stipulated in the contract
iv) Poor quality of work
v) Corrupt act of Contractor
vi) Insolvency of the Contractor
vii) Persistent disregard to the instructions of BHEL
viii) Assignment, transfer, sub-letting of contract without BHEL's written permission
ix) Non fulfillment of any contractual obligations
x) In the opinion of BHEL, the contractor is overloaded and is not in a position to execute the job as per required schedule

2.7.3 To meet the expenses including BHEL overheads on the differential cost at 5%, over and above the Liquidated damages/penalties arising out of "Risk & Cost" as explained above under Sl.No. 2.7.2. BHEL shall recover the amount from any money due from Contractor, or from any money due to the Contractor including Security Deposit, or by forfeiting any T&P or material of the contractor under this contract or any other contract of BHEL or by any other means or any combination thereof

2.7.4 To terminate the contract or to restrict the quantum of work and pay for the portion of work executed in case BHEL's contract with their customer are terminated for any reason, as per mutual agreement.

2.7.5 To effect recovery from any amounts due to the contractor under this or any other contract or in any other form, the moneys BHEL is statutorily forced to pay to anybody, due to contractor's failure to fulfill any of his obligations. BHEL shall levy overheads of 5% on all such payments along with interest as defined elsewhere in the GCC.

2.7.6 While every endeavour will be made by BHEL to this end, they cannot guarantee uninterrupted work due to conditions beyond their control. The Contractor will not be normally entitled for any compensation/extra payment on this account unless otherwise specified elsewhere in the contract.

2.7.7 In case the execution of works comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than two months, due to reasons not attributable to the contractor and other than Force Majeure conditions, BHEL may consider permitting the contractor to de mobilize forthwith and re mobilize at an agreed future date. Cost of such demobilization/remobilization shall be mutually agreed. ORC in such cases shall not be applicable for the period between the period of demobilization and re mobilisation. The duration of contract/time extension shall accordingly get modified suitably. In case of any conflict, BHEL decision in this regard shall be final and binding on the contractor.

2.7.8 In the unforeseen event of inordinate delay in receipt of materials, drawings, fronts, etc, due to which inordinate discontinuity of work is anticipated, BHEL at its discretion may consider contractor's request to short close the contract in following cases:

a) The balance works (including but not limited to Trial Operation, PG Test, etc) are minor vis a vis the scope of work envisaged as per the contract.
b) There has been no significant work in past 6 months OR no significant work is expected in next 6 months (example in Hydro projects or in projects where work has stopped due to reasons beyond the control of BHEL)
c) The balance works cannot be done within a reasonable period of time as they are dependent on unit shutdown or on other facilities of customer or any other reasons not attributable to the contractor

At the point of requesting for short closure, contractor shall establish that he has completed all works possible of completion and he is not able to proceed with the balance works due to constraints beyond his control. In such a case, the estimated value of the unexecuted portion of work ( or estimated value of services to be provided for carrying out milestone/stage payments like

Trial Operation/PG Test, etc) as mutually agreed, shall however be reduced from the final contract value.

2.7.9 LIQUIDATED DAMAGES/PENALTY

If the contractor fails to maintain the required progress of work which results in delay in the completion of the work as per the contractual completion period, BHEL shall have the right to impose Liquidated Damage/Penalty at the rate of 0. 5% of the contract value, per week of delay or part thereof subject to a maximum of 10% of the contract value. For this purpose, the period of delay shall be the delay attributable to the Contractor for the completion of work as per contract. Contract Value for this purpose, shall be the final executed value exclusive of ORC, Extra Works executed on Manday rate basis, Supplementary/Additional Items and PVC.

2.8 RESPONSIBILITIES OF THE CONTRACTOR IN RESPECT OF LOCAL LAWS, EMPLOYMENT OF WORKERS ETC.

The following are the responsibilities of the contractor in respect of observance of local laws, employment of personnel, payment of taxes etc. The subcontractor shall fully indemnify BHEL against any claims of whatsoever nature arising due to the failure of the contractor in discharging any of his responsibilities hereunder:

2.8.1 As far as possible, Unskilled Workers shall be engaged from the local areas in which the work is being executed.

2.8.2 The contractor at all times during the continuance of this contract shall, in all his dealings with local labour for the time being employed on or in connection with the work, have due regard to all local festivals and religious and other customs.

2.8.3 The contractor shall comply with all applicable State and Central Laws, Statutory Rules, Regulations etc. such as Payment of Wages Act, Minimum Wages Act, Workmen Compensation Act, Employer's Liability Act, Industrial Disputes Act, Employers Provident Act, Employees State Insurance Scheme, Contract Labour (Regulation and Abolition) Act 1970, Payment of Bonus & Gratuity Act and other Acts, Rules and Regulations for labour as may be enacted by the Government during the tenure of the Contract and having force or jurisdiction at Site. The Contractor shall also give to the local Governing Body, Police and other relevant Authorities all such notices as may be required by the Law.

2.8.4 The contractor shall obtain independent License under the Contract Labour (Regulations and Abolition Act, 1970)as required from the concerned Authorities based on the certificate (Form-V) issued by the Principal Employer/Customer

2.8.5 The contractor shall pay all taxes, fees, license charges, deposits, duties, tolls, royalties, commission or other charges which may be leviable on account of his operations in executing the contract.

2.8.6 While BHEL would pay the inspection fees and Registration fees of Boiler/Electrical Inspectorate,

all other arrangements for site visits periodically by the Inspectorate to site, Inspection certificate etc. will have to be made by contractor. However, BHEL will not make any payment to the Inspectorate in connection with contractor's Welders/Electricians qualification tests etc.

2.8.7 Contractor shall be responsible for provision of Health and Sanitary arrangements (more particularly described in Contract Labour Regulation & Abolition Act), Safety precautions etc. as may be required for safe and satisfactory execution of contract.

2.8.8 The contractor shall be responsible for proper accommodation including adequate medical facilities for personnel employed by him.

2.8.9 The contractor shall be responsible for the proper behavior and observance of all regulations by the staff employed by him.

2.8.10 The contractor shall ensure that no damage is caused to any person/property of other parties working at site. If any such damage is caused, it is responsibility of the contractor to make good the losses or compensate for the same.

2.8.11 All the properties/equipments/components of BHEL/their Client loaned with or without deposit to the contractor in connection with the contract shall remain properties of BHEL/their Client.

2.8.12 The contractor shall use such properties for the purpose of execution of this contract. All such properties/equipments/components shall be deemed to be in good condition when received by the contractor unless he notifies within 48 hours to the contrary. The contractor shall return them in good condition as and when required by BHEL/their Client. In case of non-return, loss, damage, repairs etc, the cost thereof as may be fixed by BHEL Engineer will be recovered from the contractor

2.8.13 In case the contractor is required to undertake any work outside the scope of this contract, the rates payable shall be those mutually agreed upon if the item rates are not mentioned in existing contract

2.8.14 Any delay in completion of works/or non achievement of periodical targets due to the reasons attributable to the contractor, the same may have to be compensated by the contractor either by increasing manpower and resources or by working extra hours and/or by working more than one shift. All these are to be carried out by the contractor at no extra cost.

2.8.15 The contractor shall arrange, coordinate his work in such a manner as to cause no hindrance to other agencies working in the same premises.

2.8.16 All safety rules and codes applied by the Client/BHEL at site shall be observed by the contractor without exception. The contractor shall be responsible for the safety of the equipment/material and works to be performed by him and shall maintain all light, fencing guards, slings etc. or other protection necessary for the purpose. Contractor shall also take such additional precautions as may be indicated from time to time by the Engineer with a view to prevent pilferage, accidents, fire hazards. Due precautions shall be taken against fire hazards and atmospheric conditions. Suitable number of Clerical staff, watch and ward, store keepers to take care of equipment/materials and construction tools and tackles shall be posted at site by the contractor till the completion of work

under this contract.

The contractor shall arrange for such safety devices as are necessary for such type of work and carry out the requisite site tests of handling equipment, lifting tools, tackles etc. as per prescribed standards and practices.

Contractor has to ensure the implementation of Health, Safety and Environment (HSE) requirements as per directions given by BHEL/Customer. The contractor has to assist in HSE audit by BHEL/Customer and submit compliance Report. The contractor has to generate and submit record/reports as per HSE plan/activities as per instruction of BHEL/Customer

2.8.17 The contractor will be directly responsible for payment of wages to his workmen. A pay roll sheet giving all the payments given to the workers and duly signed by the contractor's representative should be furnished to BHEL site for record purpose, if so called for.

2.8.18 In case of any class of work for which there is no such specification as laid down in the contract, such work shall be carried out in accordance with the instructions and requirements of the Engineer.

2.8.19 Also, no idle charges will be admissible in the event of any stoppage caused in the work resulting in contractor's labour and Tools & Plants being rendered idle due to any reason at any time.

2.8.20 The contractor shall take all reasonable care to protect the materials and work till such time the plant/equipment has been taken over by BHEL or their Client whichever is earlier.

2.8.21 The contractor shall not stop the work or abandon the site for whatsoever reason of dispute, excepting force majeure conditions. All such problems/disputes shall be separately discussed and settled without affecting the progress of work. Such stoppage or abandonment shall be treated as breach of contract and dealt with accordingly

2.8.22 The contractor shall keep the area of work clean and shall remove the debris etc. while executing day-to-day work. Upon completion of work, the contractor shall remove from the vicinity of work, all scrap, packing materials, rubbish, unused and other materials and deposit them in places specified by the Engineer. The contractor will also demolish all the hutments, sheds, offices, etc. constructed and used by him and shall clean the debris. In the event of his failure to do so, the same will be arranged to be done by the Engineer and the expenses recovered from the contractor.

2.8.23 The contractor shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work and timely execution shall be the essence of this contract. The contractor shall be responsible to ensure that the quality, assembly and workmanship conform to the dimensions and clearance given in the drawings and/ or as per the instructions of the Engineer.

2.8.24 The Contractor to note that some of BHEL's T&Ps/MMDs may not be insured. The Contractor will take necessary precautions and due care to protect the same while in his custody from any damage/ loss till the same is handed over back to BHEL. In case the damage / loss is due to carelessness/ negligence on the part of the contractor, the Contractor is liable to get them repair/

replaced immediately and in case of his failure to do so within a reasonable time, BHEL will reserve the right to recover the loss from the contractor.

2.9 PROGRESS MONITORING, MONTHLY REVIEW AND PERFORMANCE EVALUATION

2.9.1 A detailed plan/programme for completion of the contractual scope of work as per the time schedule given in the contract shall be jointly agreed between BHEL and Contractor, before commencement of work . The above programme shall be supported by monthwise deployment of resources viz Manpower, T&P, Consumables, etc. Progress will be reviewed periodically (Daily/Weekly/Monthly) vis a vis this jointly agreed programme. The Contractor shall submit periodical progress reports (Daily/Weekly/Monthly) and other reports/information including manpower, consumables, T&P mobilization etc as desired by BHEL.

2.9.2 Monthly progress review between BHEL and Contractor shall be based on the agreed programme as above, availability of inputs/fronts etc, and constraints if any, as per prescribed formats. Manpower, T&P and consumable reports as per prescribed formats shall be submitted by contractor every month. Release of RA Bills shall be contingent upon certification by BHEL Site Engineer of the availability of the above prescribed formats duly filled in and signed.

2.9.3 The burden of proof that the causes leading to any shortfall is not due to any reasons attributable to the contractor is on the contractor himself. The monthly progress review shall record shortfalls attributable to (i) Contractor, (ii) Force Majeure Conditions, and (iii) BHEL

2.9.4 Performance of the Contractor shall be assessed as per prescribed formats and shall form the basis for 'Annual/Overall Performance Evaluation' of the Contractor and also for 'Assessment of Capacity of Bidder' for Tenders where the Contractor is a bidder. BHEL reserves the right to revise the evaluation formats during the course of execution of the works

2.10 TIME OF COMPLETION

2.10.1 The time schedule shall be as prescribed in the Contract. The time for completion shall be reckoned from the date of commencement of work at Site as certified by BHEL Engineers

2.10.2 The entire work shall be completed by the contractor within the time schedule or within such extended periods of time as may be allowed by BHEL under clause 2.11

2.11 EXTENSION OF TIME FOR COMPLETION

2.11.1 If the completion of work as detailed in the scope of work gets delayed beyond the contract period, the contractor shall request for an extension of the contract and BHEL at its discretion may extend the Contract.

2.11.2 Based on the monthly reviews jointly signed, the works balance at the end of original contract period less the backlog attributable to the contractor shall be quantified, and the number of months of 'Time extension' required for completion of the same shall be jointly worked out. Within this period of 'Time extension', the contractor is bound to complete the portion of backlog attributable to the contractor. Any further 'Time extension' or 'Time extensions' at the end of the previous extension shall be worked out similarly.

2.11.3 However if any 'Time extension' is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take at the risk and cost of contractor.

2.11.4 A joint programme shall be drawn for the balance amount of work to be completed during the period of 'Time Extension', along with matching resources (with weightages) to be deployed by the contractor as per specified format. Review of the programme and record of shortfall shall be done

every month of the 'Time extension' period in the same manner as is done for the regular contract period.

2.11.5 During the period of 'Time extension', contractor shall maintain their resources as per mutually agreed program

2.11.6 At the end of total work completion as certified by BHEL Engineer, and upon analysis of the total delay, the portion of time extensions attributable to (i) Contractor, (ii) Force majeure conditions, and (iii) BHEL, shall be worked out and shall be considered to be exhausted in the same order. The total period of time extensions shall be the sum of (i), (ii) and (iii) above and shall be equal to period between the scheduled date of completion and the actual date of completion of contract. LD shall be imposed/levied for the portion of time extensions attributable to contractor and recoverable from the dues payable to the contractor.

2.12 OVERRUN COMPENSATION

2.12.1 Over Run Compensation (ORC) is payable for works done during the extension period, by way of rate revisions for periods beyond original contract period subject to the following terms and conditions.

2.12.2 Rates shall be increased by 10% for the first twelve months of one or more extensions beyond original contract period. For the next twelve months of further extensions if any, rates shall be increased as above by 10% over the previous twelve months, and similarly for each subsequent twelve months extension.

2.12.3 The amount of increase payable per month due to rate revisions is subject to a minimum of Rs 1,00,000/- per month and a maximum of Rs 10,00,000/- per month.

2.12.4 Should there be any 'Time extension' for reasons attributable only to the contractor, then the work shall be executed by the contractor at the rates applicable for the period the work was planned

2.12.5 Payment of ORC shall be regulated as follows:

i) Contractor is entitled to Over Run Compensation (ORC) only for the portion of backlog attributable to BHEL.

ii) 50% of the compensation as per clause 2.12.3 is allocated for deployment of resources agreed as per the joint programme drawn vide 2.11.4. Payment shall however be based on the actual deployment of resources for the month as certified by BHEL, as per weightages assigned therein

iii) 50% of the compensation as per clause 2.12.3, is allocated for achieving of planned progress agreed as per the joint programme drawn vide 2.11.4. Payment shall be on pro rata basis for actual achieved quantities

iv) Total Over Run Compensation shall be limited to 10% of the executed contract value as certified in Final Bill. For this purpose executed contract value excludes PVC, ORC, Supplementary/Additional Items and Extra Works done on Manday rate basis

2.12.6 Contractor shall not be entitled for any Over Run Compensation (ORC) for the portion of backlog attributable to the contractor. Such works shall be executed at the rates applicable for the period the work was planned

2.13 INTEREST BEARING RECOVERABLE ADVANCES

2.13.1 Normally no advance is payable to the contractor. However, advance payment in exceptional circumstances shall be interest bearing and secured through a Bank Guarantee and shall be limited to a maximum of 5% of contract value. This 'Interest Bearing Recoverable Advance' shall be

payable in not less than two installments with any of the installment not exceeding 60% of the total eligible advance.

2.13.2 In exceptional circumstances, with due justification, Competent Authority of BHEL is empowered to approve proposals for payment of additional interim interest bearing advance against Bank Guarantee, for resource augmentation towards expediting work for project implementation.

2.13.3 Bank Guarantee towards 'Interest Bearing Recoverable Advance' shall be atleast 110% of the advance so as to enable recovery of not only principle amount but also the interest portion, if so required.

2.13.4 Contractor shall establish the utilization of advance drawn before the release of next installment.

2.13.5 Payment and recovery of Interest Bearing Recoverable advance shall be at the sole discretion of BHEL and shall not be a subject matter of arbitration.

2.13.6 The rate of interest applicable for the above advances shall be the prime lending rate of State Bank of India prevailing at the time of disbursement of the advance + 2%, and such rate will remain fixed till the total advance amount is recovered

2.13.7 Unadjusted amount of advances paid shall not exceed 5% of the total contract value at any point of time. Recovery of advances shall be made progressively from each Running Bill such that the advance amounts paid along with the interest is fully recovered by the time the contractor's billing reaches 80% of contract value.

2.13.8 Recovery rate per month shall be the sum of:

a. Not less than 10% of Running Bill amount
b. Simple interest up to the date of RA Bill on the outstanding Principle amount/amounts

2.13.9 Contractor to submit Bank Guarantee as per prescribed formats for each of the advance and shall be valid for at least one year or the recovery duration or the balance contract period which ever is later. In case the recovery of dues does not get completed within the aforesaid BG period, the contractor shall renew the BG or submit fresh BG for the outstanding amount and the remaining recovery period.

2.13.10 BHEL is entitled to make recovery of the entire outstanding amount in case the contractor fails to comply with the BG requirement

2.14 QUANTITY VARIATION

2.14.1 The quoted rates shall remain firm irrespective of any variations in the individual quantities. No compensation becomes payable in case the variation of the final executed contract value is within the limits of Plus (+) or Minus (-) 15% of awarded contract value

2.14.2 Compensation due to variation of final executed value in excess of the limits defined in clause above, shall be as follows:

i) In case the finally executed contract value reduces below the lower limit of Contract Value due to quantity variation specified above, the contractor will be eligible for compensation @ 15% of the difference between the lower limit of the contract value and the actual executed value.

ii) In case the finally executed contract value increases above the upper limit of Contract Value

due to quantity variation specified above, there will be no revision in the rates within the contract period.

2.15 EXTRA WORKS

2.15.1 All rectifications/modifications, revamping, and reworks required for any reasons not due to the fault of the contractor, or needed due to any change in deviation from drawings and design of equipments, operation/maintenance requirements, mismatching, or due to damages in transit, storage and erection/commissioning, and other allied works which are not very specifically indicated in the drawings, but are found essential for satisfactory completion of the work, will be considered as extra works.

2.15.2 Extra works arising on account of the contractor's fault, irrespective of time consumed in rectification of the damage/loss, will have to be carried out by the contractor free of cost. Under such circumstances, any material and consumable required for this purpose will also have to be arranged by the contractor at his cost.

2.15.3 All the extra work should be carried out by a separately identifiable gang, without affecting routine activities. Daily log sheets in the pro-forma prescribed by BHEL should be maintained and shall be signed by the contractor's representative and BHEL engineer. No claim for extra work will be considered/entertained in the absence of the said supporting documents i.e. daily log sheets. Signing of log sheets by BHEL engineer does not necessarily mean the acceptance of such works as extra works.

2.15.4 BHEL retains the right to award or not to award any of the major repair/ rework/modification/rectification/fabrication works to the contractor, at their discretion without assigning any reason for the same

2.15.5 After eligibility of extra works is established and finally accepted by BHEL engineer/designer, payment will be released on competent authority's approval at the following rate.

MAN-HOUR RATE FOR ELIGIBLE EXTRA WORKS: Single composite average labour man-hour rate, including overtime if any, supervision, use of tools and tackles and other site expenses and incidentals, consumables for carrying out any major rework/ repairs/ rectification/ modification/ fabrication as certified by site as may arise during the course of erection, testing, commissioning or extra works arising out of transit, storage and erection damages, payment, if found due will be at Rs 60/- per man hour.

2.15.6 The above composite labour man hour rate towards extra works shall remain firm and not subject to any variation during execution of the work. PVC will not be applicable for extra works. Rate revision, Over Run Charges/compensation etc will not be applicable due to extra works.

2.15.7 Extra Works for Civil Packages shall be regulated as follows

i) Rates for Extra Works arising due to (1) non availability of BOQ (Rate Schedule), OR (2) change in Specifications of materials/works (3) rectification/modification/dismantling & re erecting etc due to no fault of Contractor, shall be in the order of the following:

a) Item rates are to be derived from similar nature of items in the BOQ (Rate Schedule) with applicable escalation derived from All India Consumer Price Index for Whole Sale Commodities.
b) As per CPWD-DSR-2007 (or latest edition) with applicable escalation derived from All India Consumer price Index for Whole Sale Commodities, OR, Notification issued by the office of CPWD for 'Cost Index' in that Region where the project is being executed, whichever is less
c) Item rates are to be worked out on the basis of prevailing market rates mutually agreed between BHEL and Contractor, plus 15% towards Contractor's overheads and profit.

ii) PVC and ORC will not applicable be for (i) above.

2.16 SUPPLEMENTARY ITEMS

2.16.1 For NON Civil Works

Supplementary items are items/works required for completion of entire work but not specified in the scope of work. Subject to certification of such items/works as supplementary items by BHEL Engineer, rates shall be derived on the basis of any one of the following on mutual agreement:

i) Based on percentage breakup/rates indicated for similar/nearby items

ii) In case (i) above does not exist, then BHEL/site may derive the percentage breakup/rates to suit the type of work

2.16.2 For Civil Works

i) Rates for Supplementary Works/Additional Works arising out due to additions/alterations in the original scope of works as per contract subject to certification of BHEL Engineer shall be worked out as under:

a) Item rates which are available in existing BOQ (Rate Schedule) shall be operated with applicable escalation derived from All India Consumer Price Index for Whole Sale Commodities
b) Items of works which are not available in existing BOQ shall be operated as an 'Extra Works' and rate shall be derived as per clause no 2.15.7

ii) Execution of Supplementary Works/Additional Works through the Contractor shall be at the sole discretion of BHEL, and shall be considered as part of executed contract value for the purpose of Quantity Variation as per clause 2.14

iii) BHEL Engineer's decision regarding fixing the rate as above is final and binding on the contractor.

iv) PVC and ORC will not be applicable for (i) above.

2.17 **PRICE VARIATION COMPENSATION**

2.17.1 In order to take care of variation in cost of execution of work on either side, due to variation in the index of LABOUR, HIGH SPEED DIESEL OIL, WELDING ROD, CEMENT, STEEL, MATERIALS, Price Variation Formula as described herein shall be applicable

2.17.2 85% component of Contract Value shall be permitted to be adjusted for variation in various relevant indices during execution of work. The remaining 15% shall be treated as fixed component

2.17.3 The basis for calculation of price variation in each category, their component, Base Index, shall be as under:

| SL NO. | CATEGORY | BASE INDEX | COMPONENT ('K') | | |
|---|---|---|---|---|---|
| | | | CIVIL PACKAGES (See Note A/B/C) | MECHANICAL PACKAGES | LABOUR ORIENTED |

| | | | A | B** | C | | PACKAGES (See Note D ) |
|---|---|---|---|---|---|---|---|
| i) | LABOUR (ALL CATEGORIES) | 'MONTHLY ALL-INDIA AVERAGE CONSUMER PRICE INDEX NUMBERS FOR INDUSTRIAL WORKERS' published by Labour Bureau, Ministry of Labour and Employment, Government of India. (Website: labourbureau.nic.in) | 40 | 25 | 30 | 65 | 80 |
| ii) | HIGH SPEED DIESEL OIL | Name of Commodity : HSD OIL. Type : INDIVIDUAL COMMODITY (See Note F) | 5 | 3 | 5 | 5 | 5 |
| iii) | WELDING ROD | Name of Commodity : WELDING ROD Type: INDIVIDUAL COMMODITY (See Note F) | | | | 15 | |
| iv) | CEMENT | Name of Commodity : GREY CEMENT Type: INDIVIDUAL COMMODITY (See Note F) | | 20 | 30 | | |
| v) | STEEL (Structural and Reinforcement Steel) | Name of Commodity : a1. IRON & SEMIS Type: GROUP ITEM (See Note F) | | 25 | | | |
| vi) | MATERIALS (Other than Cement & Steel) | Name of Commodity: ALL COMMODITIES Type: GROUP ITEM (See Note F) | 40 | 12 | 20 | | |

Note: A) Cement & Steel : Free Issue (BHEL Scope)
B) Cement & Steel : In Contractor Scope {**: unless otherwise specified in Special Conditions of Contract (SCC) }
C) Cement in Contractor Scope, and Steel is Free Issue (BHEL Scope)
D) Predominantly 'Labour Oriented' packages including Material Handling & Management, Insulation, Painting, Electrical and CI or a combination thereof, which are separately tendered and awarded
E) For Composite packages (i.e. Civil+Mechanical+Electrical/CI or Civil+Mechanical or Mechanical+Electrical/CI), the components for various categories shall be as per respective packages
F) As per the 'MONTHLY WHOLE SALE PRICE INDEX' for the respective Commodity and Type, published by Office of Economic Adviser, Ministry of Commerce and Industry, Government of India. (Website : www.eaindustry.nic.in). Revisions in the index or commodity will be re adjusted accordingly.

2.17.4 Payment/recovery due to variation in index shall be determined on the basis of the following notional formula without any initial absorption, in respect of the identified components viz LABOUR, HIGH SPEED DIESEL OIL, WELDING ROD, CEMENT, STEEL, MATERIALS

$$P = K \times R \times \frac{(X_N - X_o)}{X_o}$$

Where

P = Amount to be paid/recovered due to variation in the Index for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials

K = Percentage component applicable for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials

R = Value of work done for the billing month (Excluding Taxes and Duties if payable extra)

XN = Revised Index No for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials for the billing month under consideration

Xo = Index no for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials as on the Base date.

2.17.5 Base date shall be calendar month of the latest date of submission of Tender.

2.17.6 PVC shall not be payable for the ORC amount, Supplementary/Additional Items, Extra works.

2.17.7 The contractor shall furnish necessary monthly bulletins for the necessary indices from the relevant websites along with his Bills.

2.17.8 The contractor will be required to raise the bills for price variation payments on a monthly basis along with the running bills irrespective of the fact whether any increase/decrease in the index for relevant categories has taken place or not. In case there is delay in publication of bulletins (final figure), the provisional values as published can be considered for payments and arrears shall be paid/recovered on getting the final values.

2.17.9 PVC shall be applicable for the entire original contract period plus the extended period. However the Total Quantum of Price Variation amount payable/recoverable shall be regulated as follows:

i) For the portion of backlog attributable to the contractor, the PVC will be based on the average of the indices for the period of the original contract period.

ii) For the period of Force Majeure, the PVC will be limited to the indices applicable at the beginning of the force majeure period.

iii) For the portion of backlog attributable to BHEL, the PVC will be as per the indices applicable for the respective months

iv) The total amount of PVC shall not exceed 20% of the cumulatively executed contract value. Executed contract value for this purpose is exclusive of PVC, ORC, Supplementary/Additional Items and Extra works.

2.18 INSURANCE

2.18.1 BHEL/their customer shall arrange for insuring the materials/properties of BHEL/customer covering the risks during transit, storage, erection and commissioning.

2.18.2 It is the sole responsibility of the contractor to insure his materials, equipments, workmen, etc. against accidents and injury while at work and to pay compensation, if any, to workmen as per Workmen's compensation Act. The work will be carried out in a protected area and all the rules and regulations of the client /BHEL in the area of project which are in force from time to time will have to be followed by the contractor.

2.18.3 If due to negligence and or non-observation of safety and other precautions by the contractors, any accident/injury occurs to the property / manpower belong to third party, the contractor shall have to pay necessary compensation and other expense, if so decided by the appropriate authorities.

2.18.4 The contractor will take necessary precautions and due care to protect the material, while in his custody from any damage/ loss due to theft or otherwise till the same is taken over by BHEL or customer. For lodging / processing of insurance claim the contractor will submit necessary documents. BHEL will recover the loss including the deductible franchise from the contractor, in case the damage / loss is due to carelessness / negligence on the part of the contractor. In case of any theft of material under contractor's custody , matter shall be reported to police by the contractor immediately and copy of FIR and subsequently police investigation report shall be submitted to BHEL for taking up with insurance. However this will not relieve the contractor of his

contractual obligation for the material in his custody.

2.19 STRIKES & LOCKOUT

2.19.1 The contractor will be fully responsible for all disputes and other issues connected with his labour. In the event of the contractor's labour resorting to strike or the Contractor resorting to lockout and if the strike or lockout declared is not settled within a period of one month, BHEL shall have the right to get the work executed through any other agencies and the cost so incurred by BHEL shall be deducted from the Contractor's bills.

2.19.2 For all purposes whatsoever, the employees of the contractor shall not be deemed to be in the employment of BHEL

2.20 FORCE MAJEURE

The following shall amount to Force Majeure:-

2.20.1 Acts of God, act of any Government, War, Sabotage, Riots, Civil commotion, Police action, Revolution, Flood, Fire, Cyclones, Earth quake and Epidemic and other similar causes over which the contractor has no control.

2.20.2 If the contractor suffers delay in the due execution of the contractual obligation due to delays caused by force majeure as defined above, the agreed time of completion of the job covered by this contract or the obligations of the contractor shall be extended by a period of time equal to period of delay, provided that on the occurrence of any such contingency, the contractor immediately reports to BHEL in writing the causes of delay and the contractor shall not be eligible for any compensation.

2.21 ARBITRATION & RECONCILIATION

2.21.1 In case amicable settlement is not reached in the event of any dispute or difference arising out of the execution of the Contract or the respective rights and liabilities of the parties or in relation to interpretation of any provision by the Contractor in any manner touching upon the Contract, such dispute or difference shall (except as to any matters, the decision of which is specifically provided for therein) be referred to the sole arbitration of the arbitrator appointed by BHEL/In charge(Region).

The award of the Arbitrator shall be binding upon the parties to the dispute

Subject as aforesaid, the provisions of Arbitration and Reconciliation Act 1996 (India) or statutory modifications or re enactments thereof and the rules made there under and for the time being in force shall apply to the arbitration proceedings under this clause. The venue of the arbitration shall be the place from which the contract is issued or such other place as the Arbitrator at his discretion may determine

2.21.2 In case of Contract with Public Sector Enterprise (PSE) or a Government Department, the following shall be applicable :

In the event of any dispute or difference relating to the interpretation and application of the provisions of the Contract, such dispute or difference shall be referred to by either party to the arbitration of one of the arbitrators in the department of public enterprises. The award of the arbitrator shall be binding upon the parties to the dispute, provided, however, any party aggrieved by such award may make further reference for setting aside or revision of the award to the Law Secretary, Department of Legal Affairs, Ministry of Law and Justice, Government of India. Upon such reference the dispute shall be decided by the Law Secretary or the Special Secretary or Additional Secretary when so authorized by the Law Secretary, whose decision shall bind the parties hereto finally and conclusively.

2.21.3 The cost of arbitration shall be borne equally by the parties.

2.21.4 Work under the contract shall be continued during the arbitration proceedings

2.22 RETENTION AMOUNT

2.22.1 Retention Amount shall be 5% of executed contract value and shall be recovered at the rate of 5% from each Running Bill admitted, including PVC Bills.

2.22.2 Refund of Retention Amount shall be as follows:

i) 50% of retention amount along with 'Final Bill'

ii) Balance 50% of retention amount shall be retained towards 'Performance Guarantee for Workmanship' and shall become refundable after expiry of Guarantee period, provided all the defects noticed during the guarantee period have been rectified to the satisfaction of BHEL Site Engineer/BHEL Construction Manager, and after deducting all expenses/other amounts due to BHEL under the contract/other contracts entered into by BHEL with them. This portion of the retention amount can be released on commencement of the Guarantee period, on submission of equivalent Bank Guarantee.

2.23 PAYMENTS

Payments to Contractors are made in any one of the following forms

2.23.1 Running Account Bills (RA Bills)

i) These are for interim payments when the contracts are in progress. The bills for such interim payments are to be prepared by Contractor in prescribed formats (RA Bill forms).

ii) Payments shall be made according to the extent of work done as per measurements taken up to the end of the calendar month and in line with the terms of payments described in the Tender documents

iii) Recoveries on account of electricity, water, statutory deductions, etc are made as per terms of contract

iv) Full rates for the work done shall be allowed only if the quantum of work has been done as per the specifications stipulated in the contract. If the work is not executed as per the stipulated specifications, BHEL may ask the contractor to re do the work according to the required specifications, without any extra cost. However, where this is not considered necessary 'OR' where the part work is done due to factors like non-availability of material to be supplied by BHEL 'OR' non availability of fronts 'OR' non availability of drawings, fraction payment against full rate, as is considered reasonable, may be allowed with due regard for the work remaining to be done. BHEL decision in this regard will be final and

binding on the contractor.

v) In order to facilitate part payment, BHEL Site Engineer at his discretion may further split the contracted rates/percentages to suit site conditions, cash flow requirements according to the progress of work

2.23.2 Final Bill

Final Bill' is used for final payment on closing of Running Account for works or for single payment after completion of works. 'Final Bill' shall be submitted as per prescribed format after completion of works as per scope and upon material reconciliation, along with the following.

i) 'No Claim Certificate' by contractor
ii) Clearance certificates where ever applicable viz Clearance Certificates from Customer, various Statutory Authorities like Labour department, PF Authorities, Commercial Tax Department, etc
iii) Indemnity bond as per prescribed format

BHEL shall settle the final bills after deducting all liabilities of Contractor to BHEL

2.24 PERFORMANCE GUARANTEE FOR WORKMANSHIP

2.24.1 Even though the work will be carried out under the supervision of BHEL Engineers the Contractor will be responsible for the quality of the workmanship and shall guarantee the work done for a period of twelve months from the date of commencement of guarantee period as defined in Special Conditions of Contract, for good workmanship and shall rectify free of cost all defects due to faulty erection detected during the guarantee period. In the event of the Contractor failing to repair the defective works within the time specified by the Engineer, BHEL may proceed to undertake the repairs of such defective works at the Contractor's risk and cost, without prejudice to any other rights and recover the same from the Guarantee money.

2.24.2 BHEL shall release the guarantee money subject to the following

i) Contractor has submitted 'Final Bill'
ii) Guarantee period as per contract has expired
iii) Contractor has furnished 'No Claim Certificate' in specified format
iv) BHEL Site Engineer/Construction Manager has furnished the 'No Demand Certificate' in specified format
v) Contractor has carried out the works required to be carried out by him during the period of Guarantee and all expenses incurred by BHEL on carrying out such works is included for adjustment from the Guarantee money refundable.

2.25 CLOSING OF CONTRACTS

The Contract shall be considered completed and closed upon completion of all contractual obligations and settlement of Final Bill or completion of Guarantee period whichever is later. Upon closing of Contract, BHEL shall issue a completion certificate as per standard format, based on specific request of Contractor.

2.26 REVERSE AUCTION:

BHEL reserves the right to go for Reverse Auction for Price Bid Opening by BHEL appointed service provider, instead of opening the submitted sealed price bid in the conventional way. The Business Rules for Reverse Auction shall be as per BHEL guidelines issued from time to time.

2.27 SUSPENSION OF BUSINESS DEALINGS

BHEL reserves the right to take action against Contractors who either fail to perform or Tenderers/Contractor who indulge in malpractices, by suspending business dealings with them in

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| | line with BHEL guidelines issued from time to time. |
| 2.28 | OTHER ISSUES |
| 2.28.1 | Value of Non judicial Stamp Paper for Bank Guarantees and for Contract Agreement shall be not less than Rs 100/- unless otherwise required under relevant statutes. |
| 2.28.2 | In case of any conflict between the General Conditions of Contract and Special Conditions of Contract, provisions contained in the Special Conditions of Contract shall prevail. |
| 2.28.3 | Unless otherwise specified in NIT, offers from consortium/JVs shall not be considered. |
| 2.28.4 | BHEL may not insist for signing of Contract Agreements in respect of low value and short time period contracts like providing services for Hot water flushing, Chemical Cleaning, Transportation, etc |

**TENDER NO: PSER:SCT:NBN-C2067:20**

**VOLUME -ID**

# SPECIAL CONDITIONS OF CONTRACT

**FOR**

CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.


## BHARAT HEAVY ELECTRICALS LIMITED

**( A GOVT. OF INDIA UNDERTAKING )**
**POWER SECTOR – EASTERN REGION**
**PLOT NO. – 9 / 1, DJ – BLOCK,**
**SECTOR – II, KARUNAMOYEE,**
**SALT LAKE CITY,**
**KOLKATA – 700091.**

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| 1.0 | INTENT OF THE SPECIFICATION |
| 1.1 | The intent of this erection specification is to provide services for execution of the project according to most modern and proven techniques and codes. The omission of specific reference to any method, equipment or material necessary for the proper and efficient services towards installation of the plant shall not relieve the contractor of the responsibility of providing such services / facilities to complete the work or portion of work awarded to him. The quoted / accepted rates / price shall deem to be inclusive of all such contingencies. |
| 1.2 | The work shall conform to dimensions and tolerances given in various drawings and documents that will be provided during erection. If any portion of works is found to be defective in workmanship and not conforming to drawings / documents or other stipulations, the contractor shall dismantle and re-do the work duly replacing the defective materials at their own cost, failing which recoveries, as determined by BHEL, shall be effected from contractor's bills. |
| 1.3 | It is not the intent of this specification to specify herein all the details of erection and commissioning. However, the system shall conform in all respects to high standards of quality and workmanship for performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgments is not in full accordance herewith. |
| 1.4 | The omission of specific reference to any fabrication / erection or other method, equipment or material necessary for proper and efficient working of the plant shall not relieve the tenderer of the responsibility of providing such facilities to complete the work at quoted rates. Any mismatch/ defect found due to mistake in fabrication / erection shall have to be rectified by the vendor free of cost. Inspection by BHEL/Customer does not relieve vendor of his responsibility of executing quality erection. |
| 1.5 | The work covered under this specification is of highly sophisticated nature, requiring the best quality workmanship, supervision, engineering and construction management. The contractor should ensure proper planning and successful and timely completion of the work to meet the overall project schedule. The contractor must deploy adequate quantity of tools & plants, modern / latest construction aids etc. He must also deploy adequate trained, qualified and experienced supervisory staff and skilled personnel. |

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| 1.6 | Contractor shall erect and commission all the equipments and auxiliaries as per the sequence & methodology prescribed by BHEL depending upon the technical requirements. Availability of materials and fronts will decide this. BHEL Engineer's decision regarding correctness of the work and method of working shall be final and binding on the contractor. No claims for extra payment from the contractor will be entertained on the ground of deviation from the methods / sequence adopted in erection of similar sets elsewhere. |
| 1.7 | Following shall be the minimum responsibility of contractor and have to be provided within finally accepted rates / prices: |
| 1.7.1 | Provision as required of all types of labour, supervisors, engineers, watch and ward, tools & tackles, calibrated MMEs (Monitoring and Measuring Equipment) as specified and otherwise required for the work, consumables for erection, testing and commissioning including material handling |
| 1.7.2 | Achieving Proper out-turn / Turn-over as per BHEL plan and commitment. |
| 1.7.3 | Completion of work as per BHEL Schedule |
| 1.7.4 | Good quality and accurate workmanship for proper performance of the equipment |
| 1.7.5 | Repair and rectification |
| 1.7.6 | Preservation / Re-conservation of all components during storage / erection / commissioning till handing over. |

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| 2.0 | GENERAL SERVICES TO BE RENDERED BY THE BIDDER |
| 2.1 | Services for construction, fabrication, equipment erection testing as well as trial run & commissioning of various equipment and accessories under the contract shall include but not be limited to the following: |
| 2.2 | Issuing materials from store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant/equipment is officially taken over by the owner / BHEL after complete erection any successful trial run & commissioning. |
| 2.3 | Transport of material to their respective places of erection and erection of the complete plant & equipment as supplied under this specification. |
| 2.4 | Trial run and commissioning of individual equipment / sub-systems to the satisfaction of Owner/BHEL. |
| 2.5 | Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to the rendered under this specification. |
| 2.6 | Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under scope of this specification except otherwise specified. |
| 2.7 | Supply of all consumables, eg welding electrodes, cleaning agents, diesel oil, lubricant etc as well as materials required for temporary supports, scaffolding etc as necessary for such erection work, unless specified other wise. |
| 2.8 | Providing support services for the contractor's erection staff eg construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, watch and ward for security and safety of the materials under the Contractor's custody etc. as required. |
| 2.9 | Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with BHEL, Submission of monthly progress reports and any such document as and when desired by BHEL/owner, taking approval of all statutory authorities i.e Boiler Inspector, Factory Inspector, Inspector of Explosives etc , as applicable for respective portions of work fall under the jurisdiction of such statutes of laws. |
| 2.10 | Any other service, although not specifically called for but required for a contract of the size and nature indicated in the specification. |

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| 3.0 | GENERAL TECHNICAL REQUIREMENTS (CODES AND STANDARDS) |
| 3.1 | Except where otherwise specified, the plant/equipment shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as mentioned elsewhere in contract specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary, to enable BHEL to identify all of the plant/equipment in the same detail as would be possible had there been a Standard Specification. |
| 3.2 | Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification. |
| 3.3 | In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements which are more stringent shall govern. |
| 3.4 | Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer. |

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| 4.0 | OBLIGATIONS OF CONTRACTOR |
| 4.1 | CONSUMABLES & OTHER ITEMS |
| 4.1.1 | The contractor shall provide within finally accepted price / rates, all consumables (excepting those indicated in BHEL scope) like welding electrodes (including alloy steel and stainless steel), filler wires, TIG filler wires (over & above as supplied by the unit along with the plant materials, which will be given free of cost to bidder), gases (inert, welding, cutting), soldering material, dye penetrants, radiography films, etc. Other erection consumables such as tapes, jointing compound, grease, mobile oil, M-seal, Araldite, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, packers, shims, wooden planks, scaffolding materials hardware items etc required for temporary works such as supports, scaffoldings are to be arranged by the contractor. Sealing compounds, gaskets, gland packing, wooden/concrete sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by the contractor. |
| 4.1.2 | All the shims, gaskets and packing, which go finally as part of plant equipment, shall be supplied by BHEL free of cost. |
| 4.1.3 | It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of consumables. Non-availability of any consumable materials or equivalent suggested by BHEL cannot be considered as reason for not attaining the required progress or for additional claim. |
| 4.1.4 | <u>TIG Filler wire for Boiler and Filler wires for Electrodes for P91/T91 piping:</u><br>These shall be supplied by BHEL free of cost as supplied by BHEL Manufacturing Units as part of regular supply. Required quantity as arrived at by calculation / standards will only be supplied. It would be the contractors' responsibility to account for the consumption of these filler wires. Additional consumption beyond standard / calculated quantity will be at cost recovery basis only unless and otherwise accounted for. Surplus quantity of TIG filler wire, if any, shall be properly stored and returned to BHEL stores. |
| 4.1.5 | It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of electrodes etc before procurement of welding electrodes. On receipt of electrodes at site these shall be subjected to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number, date of expiry etc and produce test certificate for each lot / batch with correlation of batch / lot number with respective test certificate. No |

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| | electrode without a valid test certificate will to be used. |
| 4.1.6 | BHEL reserves the right to reject the use of any consumable including electrodes, gases, lubricants / special consumables if it is not found to be of the required standard / make / purity or when shelf life has expired. Contractor shall ensure display of shelf life on consumable wherever required and records maintained. |
| 4.1.7 | Storage of all consumables including welding electrodes shall be done as per requirement / instruction of the Engineer by the contractor at his cost. |
| 4.1.8 | In case of improper arrangement for procurement of any consumable, BHEL reserves the right to procure the same from any source and recover the cost from the Contractor's first subsequent bill at market value plus the departmental charges of BHEL from time to time. Postponement of such recovery is normally not permitted. The decision of Engineer in this regard shall be final and binding on the Contractor. |
| 4.1.9 | All lubricants and chemicals required for pre-commissioning, commissioning, testing, preservation and lubricants for trial runs of the equipment shall be supplied by BHEL / BHEL's client. All services including labour and T&P will be provided by the contractor for handling, filling, emptying, refilling etc. The consumption of lubricants / chemicals shall be properly accounted for. Surplus material if any shall be properly stacked/tagged and returned to BHEL/ CUSTOMER stores at no extra cost to BHEL. BHEL reserves the right to recover costs for wastage by the contractor. |
| 4.1.10 | Transportation of oil drums, from stores, filling of oil for flushing, first filling, subsequent changeover if any, topping/making up till the unit is fully commissioned and handed over to customer is included in scope of this contract. The contractor shall have to return all the empty drums to BHEL / BHEL's client store at no extra cost. Any loss / damage to above drums shall be to contractor's account. |
| 4.1.11 | All charges on account of Octroi, terminal or sales tax and other duties on materials obtained from any source for carrying out the works in the scope of the contractor shall be borne by the contractor. |
| 4.2 | TOOLS AND PLANTS / MONITORING AND MEASURING EQUIPMENT (MMEs) |
| 4.2.1 | T&Ps and MMEs to be provided by Contractor |
| 4.2.1.1 | All T&Ps and MMEs excepting those specifically indicated in BHEL scope are to be provided by the Contractor. Contractor has to make his own arrangement at his cost for completing the formalities (including arrangement of Road permits, if any) if required with Sales Tax/VAT authorities, for bringing their materials, plants and |

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| | equipments at site for the execution of work under this contract. |
| 4.2.1.2 | All suitable cranes, lifting and transport equipments for material handling at stores/yard/siding of BHEL/Customer are included in scope. BHEL's cranes will not be available for this purpose unless otherwise specifically permitted as per contract conditions |
| 4.2.1.3 | All T&Ps to be deployed by the contractor shall have the approval of BHEL Engineer with regard to brand, quality and specification. |
| 4.2.1.4 | Indicative list of Major T&Ps in the scope of Contractor are given in the Technical Conditions of Contract. Bidders to note that these are only indicative and as such all other T&P necessary for timely and satisfactory completion of work in scope shall be mobilized by Contractor |
| 4.2.1.5 | Timely deployment of adequate T&Ps is the responsibility of the contractor. The contractor shall be prepared to augment the T&P at short notice to match the planned programme and to achieve the milestones. |
| 4.2.1.6 | Contractor shall maintain and operate his tools and plants in such a way that major breakdowns are avoided. In the event of major breakdown, contractor shall make alternative arrangements expeditiously so that the progress of work is not hampered. |
| 4.2.1.7 | In the event of contractor failing to arrange the required tools, plants, machinery, equipment, material or non-availability of the same owing to breakdown, BHEL will make alternative arrangement at the risk and cost of the contractor. Decision of BHEL shall be final and binding on the contractor |
| 4.2.1.8 | The T&P to be arranged by the contractor shall be in proper working condition and their operation shall not lead to unsafe condition. The movements of cranes, and other equipment should be such that no damage / breakage occurs to foundations, other equipments, material, property and men. All arrangements for the movement of the T&P etc shall be the contractor's responsibility. |
| 4.2.1.9 | Use of welding generators/ rectifiers only shall be permitted for welding. Use of welding transformers will be subject to specific approval of BHEL engineer. |
| 4.2.1.10 | The contractor at his cost shall carry out periodical testing of his construction equipments. Test certificates shall be furnished to BHEL. |
| 4.2.1.11 | Contractor shall ensure deployment of serviced and healthy T&Ps including cranes, lifting tackles, wire ropes, manila ropes, winches and slings etc. History card and maintenance records for major T&Ps will be maintained by the contractor and will be made available to BHEL Engineer for inspection as and when required. |

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| | Fitness certificate / Test Certificates of T&P shall have to be submitted before it is put in use. Identification for such T&Ps will be done as per BHEL Engineer's advice.<br>BHEL reserves the right to permit only new slings up to 20 mm and lifting tackles up to 3 MT capacities. |
| 4.2.1.12 | Contractor shall ensure deployment of reliable and calibrated MMEs (Inspection measuring and Monitoring equipment). The MMEs shall have test / calibration certificates from authorized / Government approved / accredited agencies traceable to National / International standards. Each MME shall have a label indicating calibration status i.e. date of calibration, calibration agency and due date for calibration. A list of such instruments deployed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control. |
| 4.2.1.13 | Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer within the contract price. The contractor will also have alternate arrangements for such MME so that work does not suffer when the particular instrument is sent for calibration. If any MMEs not found fit for use, BHEL shall have the right to stop the use of such item. It will be necessary for the contractor to deploy proper item. Any readings taken by the defective instrument will be recalled and repeat the readings taken by that instrument with a proper one. In case he fails to do so, BHEL may deploy MMEs and retake the readings at contractor's cost. |
| 4.2.1.14 | BHEL shall have lien on all T&P, MMEs and other equipment of the contractor brought to the site for the purpose of erection, testing and commissioning. BHEL shall continue to hold the lien on all such items throughout the period of contract / extended period. The contractor and / or his sub-contractors, without the prior written approval of the Engineer, shall remove no material brought to the site. |
| 4.2.1.15 | The month wise T&P deployment plan to execute the work is to be submitted as per relevant format as per the instruction of BHEL. It shall be the contractor's responsibility to deploy the required T&P, for timely and successful completion of the job, to any extent. |
| 4.2.2 | Obligations in respect of T&Ps and MMEs provided by BHEL |
| 4.2.2.1 | T&P / MMEs being provided by BHEL to sub-contractor free of hire charges shall be shared by other subcontractors working for BHEL at site and the allotment done by BHEL Engineer shall be final and binding. |
| 4.2.2.2 | BHEL T&P will be issued in basic assembled condition. Additional loose components / sub-assemblies / attachments as and when necessary, will be |

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| | issued by BHEL. Assembly of such additional loose components/sub-assemblies/ attachments is in contractor's scope. |
| 4.2.2.3 | In case of non-availability of the T&Ps to be provided by BHEL due to breakdown, major overhauls, distribution pattern or any other reason, the contractor shall plan / amend / alter his activities to meet erection / commissioning targets in consultation with BHEL. |
| 4.2.2.4 | void |
| 4.2.2.5 | The contractor shall engage trained and experienced operators for the operation of BHEL's T&Ps. Their skill / performance will be checked by BHEL Engineer before they are allowed to operate the same. However checking of skills by BHEL does not absolve the contractor of his responsibilities for proper and safe handling of equipment, consistent good performance of operators and regular performance evaluation of operators. |
| 4.2.2.6 | The day to day operation and maintenance of BHEL's T&Ps (Other than cranes) shall be carried out by contractor as per manufacturer's / BHEL's maintenance schedule at his cost. The contractor shall arrange, at his own cost, trained operators, fuel and other consumables for their operation.BHEL shall arrange all spares needed for upkeep of major T&Ps provided like Huck Bolting Machine*, DG Set, Induction Machine and Hydraulic Test pumps. The contractor has to arrange for fixing of the spares; supervision in specialized cases will be provided by BHEL. For upkeep of all other T&Ps supplied by BHEL, spares shall be arranged by the Contractor. BHEL supplied T&Ps shall be maintained in good working condition during the entire period of use. T&Ps in defective / damaged condition shall be rectified promptly to the full satisfaction of BHEL engineer. Contractor shall maintain records for maintenance of major T&Ps. These shall be made available for Inspection whenever required. In case of any lapses on the part of the contractor, BHEL at its own discretion shall get the servicing / repair of equipment done at the risk and cost of the contractor along with BHEL overheads. Further, if there are breakdowns / damages due to negligence of the contractor, the complete service / repair charges and cost of all the spares damaged with BHEL overheads shall be recovered from contractor's RA bills.<br>*: for operation and maintenance of ESP Huck bolting machine, BHEL shall provide the basic power rig and hose. Balance toolingsie Guns, chuck jaws etc are to be arranged by contractor. |
| 4.2.2.7 | void |

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| 4.2.2.8 | Increasing / shortening of the crane boom to suit work requirements shall have to be arranged by the indenting contractor at his cost including restoration to a state as directed by BHEL. All necessary manpower tools, support, consumables, illumination etc. will have to be arranged by contractor at his cost. If required, contractor has to return the crane with original boom. |
| 4.2.2.9 | The area and infrastructure development of the area to be carried out by the customer. However in construction projects of this magnitude it is possible that all the areas / approaches may not be ready. In such cases backfilling of approaches where ever necessary, consolidation of ground and arrangement of sleepers / sand bag filling etc for safe operation / movement of equipment including cranes / trailers etc shall be the responsibility of the contractor at his cost. No compensation on this account shall be payable. |
| 4.2.2.10 | In the event of contractor not using and maintaining BHEL T&Ps according to BHEL's instructions. BHEL will have the right to withdraw such item without any notice and no claim in this regard shall be entertained and contractor shall be responsible for delay in execution on this account. |
| 4.2.2.11 | The contractor shall furnish regular utilization report of the BHEL T&Ps, as per requirement of BHEL. |
| 4.2.2.12 | Any loss / damage to any part of BHEL T&Ps and MMEs shall be to the contractor's account and any expenditure on these accounts by BHEL will be recovered from the contractor's bill in case the contractor fails to make good the loss. |
| 4.2.2.13 | It shall be responsibility of the contractor to take delivery of T&Ps and MMEs from stores or place of use by other contractor at project site, transport the same to site and return the same to BHEL store / place as intimated by Engineer in project site in good working conditions after use. |
| 4.2.2.14 | The contractor shall return BHEL T&Ps and MMEs issued to him in good working condition as and when desired by BHEL (on completion or reduction of workload). If contractor delays return of T&P and MME, hire charges as applicable shall be levied by BHEL from time, it was requisitioned till the time of actual return.<br>T&Ps and MMEs returned in damaged / unserviceable condition shall be got repaired by BHEL at its own discretion and entire cost of repair with BHEL overheads shall be recovered from the contractor. |
| 4.2.2.15 | Replacement cost including BHEL overheads in respect of irreparable / completely damaged / non return of T&Ps and MMEs shall be recovered from the |

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| | contractor's running / final bills |
| 4.2.2.16 | Obligations in respect of Cranes provided by BHEL |
| a) | BHEL will make available the cranes (as per Technical Conditions of Contract) free of charge to the contractor on sharing basis mainly for the purposes enumerated/indicated therein. BHEL cranes have to be shared with other agencies / contractors of BHEL. The allocation of cranes shall be the discretion of BHEL engineer, which shall be binding on the contractor. |
| b) | BHEL Cranes may be initially issued in basic assembled condition. Any alteration/addition like boom reduction / extension, assembly of components/sub-assemblies needed for modulating the capacity/reach/other features of cranes and restoration to the state as directed by BHEL shall be the contractor's responsibility. |
| c) | In case the BHEL cranes are not covered under AMC of BHEL, then the day-to-day upkeep and running maintenance like filling / topping up of lubricants, changing filters, etc including repair of self starter and dynamo of these cranes shall be the responsibility of the contractor.If on checking it is found that the same is not followed, BHEL will exercise its right to get the job/works done at the risk and cost of contactor.<br><br>In case BHEL cranes are covered under AMC awarded by BHEL, then the day-to-day upkeep and running maintenance as described above are excluded from scope. However any additional helpers if any required during Preventive/Breakdown Maintenance, Assembly/disassembly shall be provided by contractor at no extra cost.<br><br>BHEL may also provide cranes through crane hiring agencies in which case the day-to-day upkeep and running maintenance shall be excluded from scope of contractor. |
| d) | Minor consumables like cotton cloth, cotton waste, etc is to be supplied by Contractor. All spares and lubricants/grease is excluded from scope. Contractor to give the requirements of these items well in advance in case the cranes provided by BHEL are BHEL owned cranes. |
| e) | Unless otherwise specified, trained operators for BHEL owned cranes shall be provided by the contractor. These operators should possess valid license for heavy vehicle. |
| f) | BHEL cranes will be withdrawn for regular and capital maintenance as per the respective schedule of maintenance. As far as possible such schedules will be intimated to the contractor in advance and may be adjusted depending on the work |

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| | requirements at site. However no claim whatsoever will be entertained on account of non-availability of cranes. |
| g) | Where the services of the cranes provided by BHEL are to be shared by other agencies/ contractors of BHEL, the contractor's responsibilities defined above will also be apportioned accordingly to the beneficiary agency. Working arrangements in this regard will be done at site by BHEL engineer and in any case his decision shall be final and binding. |
| h) | Major breakdowns will be attended to by BHEL. However, in case of breakdowns or damages due to negligence of the contractor, the complete service/repair charges including cost of spares shall be to the account of the contractor, along with BHEL overheads. |
| 4.2.2.17 | Obligations in respect of Construction Lift/Elevators provided by BHEL |
| a) | The total erection including commissioning, maintenance, statutory clearances shall be in included in scope of work. Supervision by the original equipment supplier or their authorized agency shall be arranged for by BHEL, in case found necessary. |
| b) | All day to day and routine maintenance and checking is to be carried out by the contractor as per the recommendations of the supplier. He should periodically check the brakes and carry out the all works to ensure the safety of all those using the lift/elevator. BHEL shall arrange spares required for upkeep of Construction lift/elevator |
| c) | The construction lift/elevator should never be overloaded as this can lead to serious accidents. Ensuring all safety aspects in operation of the lift shall be the responsibility of the contractor. Erection of all the required number of landing platforms is included in scope. Landing platforms are to be provided with proper barricades and hand railings. |
| d) | After completion of contractual scope of work or as per BHEL advice, the temporary elevator/lift shall be dismantled and handed over to BHEL neatly identified/tagged. Temporary structures/platforms etc erected for the elevators/lifts are also to be dismantled and materials to be returned to stores as applicable. The construction and dismantling of the foundations required for the construction/elevator lifts is includedin the scope of the contractor. |

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| 5.0 | RESPONSIBILITIES OF CONTRACTOR IN RESPECT OF LABOUR, SUPERVISORY STAFF, ETC. |
| 5.1 | Refer relevant clauses of General Conditions of Contract (GCC) also in this regard |
| 5.2 | The contractor shall deploy all the necessary skilled/semiskilled/ unskilled labour including highly skilled workmen etc. These workmen should have previous experience on similar job. They shall hold valid certificates wherever necessary. BHEL reserves the right to insist on removal of any employee of the contractor at any time if he is found to be unsuitable and the contractor shall forthwith remove him. |
| 5.3 | Contractor shall also comply with the requirements of local authorities/ project authorities calling for police verification of antecedents of the workmen, staff etc. |
| 5.4 | It is the responsibility of the contractor to engage his workmen in shifts and or on overtime basis for achieving the targets set by BHEL. This target may be set to suit BHEL's commitments to its customer or to advance date of completion of events or due to other reasons. The decision of BHEL in regard to setting the erection and commissioning targets will be final and binding on the contractor. |
| 5.5 | Contractor shall provide at different elevation suitable arrangement for urinal and drinking water facility with necessary plumbing & disposal arrangement including construction of septic tank. These installations shall be maintained in hygienic condition at all times. |
| 5.6 | The Contractor in the event of engaging 20 or more workmen, shall obtain Independent license under the Contract labour (Regulation and Abolition) Act 1970 from the concerned authorities based on Form-V issued by the Principal Employer/Customer. In order to issue Form-V by Customer, Contractor shall fulfill all Statutory requirements like Insurance Policy, PF Code/PF Account number etc as per the requirement of BHEL/Customer |
| 5.7 | Contractor shall deduct the necessary amount towards Provident Fund and contribute equal amount as per Government of India laws. This amount will be deposited regularly to the provident Fund Commissioner. BHEL/Customer may insist for submission of the account code duly certified by PF Commissioner |
| 5.8 | Contractor may also be required to comply with provisions of ESI Act in vogue if applicable and submit evidence to BHEL. |
| 5.9 | BHEL / customer may insist for witnessing the regular payment to the labour. They may also like to verify the relevant records for compliance with statutory |

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| | requirements. Contractor shall enable such facilities to BHEL / Customer. |
| 5.10 | Contractor shall deploy only qualified and experienced engineers/ supervisors. They shall have professional approach in executing the work. |
| 5.11 | The contractor's supervisory staff shall execute the work in the most professional manner in the stipulated time. Accuracy of work and aesthetic finish are essential part of this contract. They shall be responsible to ensure that the assembly and workmanship conform to dimensions and tolerances given in the drawings/instructions given by BHEL engineer from time to time. |
| 5.12 | The supervisory staff employed by the contractor shall ensure proper outturn of work and discipline on the part of the labour put on the job by the contractor. Also in general they should see that the works are carried out in a safe and proper manner and in coordination with other labour and staff employed directly by BHEL or other contractors of BHEL or BHEL's client. |
| 5.13 | It is the responsibility of the contractor to arrange gate pass for all his employees, T&P etc for entering the project premises. Necessary coordination with customer officials is the responsibility of the contractor. Contractor to follow all the procedures laid down by the customer for making gate passes. Where permitted, by customer / BHEL, to work beyond normal working hours, the contractor shall arrange necessary work permits for working beyond normal working hours. |
| 5.14 | The actual deployment will of Labour and Engineer/supervision staff shall be so as to satisfy the erection and commissioning targets set by BHEL. If at any time, it is found that the contractor is not in a position to deploy the required engineers/supervisors/workmen due to any reason, BHEL shall have the option to make alternate arrangements at the contractor's risk and cost.The expenditure incurred along with BHEL overheads thereon shall be recovered from the contractor |
| 5.15 | Contractor shall not deploy women labour at night. |

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| 6.0 | MATERIAL HANDLING, STORAGE AND PRESERVATION ETC |
| 6.1 | MATERIAL HANDLING AND STORAGE |
| 6.1.1 | All the equipments/materials furnished under this contract shall be received from the project stores, sheds / storage yards and transported to pre assembly area / erection site and stored in the storage spaces in a manner so that they are easily retrievable till the contractor erects them. While drawing/lifting material from BHEL / customer stores, the contractor shall ensure that the balance / other materials are stacked back immediately. No claim is admissible on this account |
| 6.1.2 | While BHEL will endeavor to store / stack / identify materials properly in their open / close / semi closed / tarpaulins covered storage yard / shed, it shall be contractor's responsibility to assist BHEL in identifying materials well in time for erection. They should take the delivery of the same, following the procedure indicated by BHEL, and transport the material safely to pre-assembly yard / erection site in time, according to program. |
| 6.1.3 | The contractor shall take delivery of components, equipment / consumables from storage area after getting the approval of BHEL Engineer on standard indent forms. |
| 6.1.4 | The contractor shall identify and deploy necessary Engineers / supervisors / workmen for the above work in sufficient number as may be needed by BHEL, for areas covering their scope. |
| 6.1.5 | All the equipment shall be handled very carefully to prevent any damage or loss. No untested wire ropes / slings etc. shall be used for unloading / handling. The equipment shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the stores shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at site. |
| 6.1.6 | Contractor shall ensure that while lifting slings shall be put over the points indicated on the equipment or as indicated in the manufacturer's drawings. Slings / shackles of proper size shall be used for all lifting and rigging purposes. All care shall be taken to safe guard the equipment against any damage. Dragging of piping / valves should be avoided. In case of any damage the cost shall be covered from the contractor. |
| 6.1.7 | Approach road conditions from the stores / yards to the erection site may not |

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| | be equipped and ideal for smooth transportation of the equipment. Contractor may have to be adequately prepared to transport the materials under the above circumstances without any extra cost. . The contractor may familiar himself with soil conditions at site. |
| 6.1.8 | Contractor shall be responsible for examining all the plant and materials issued to him and notify the Engineer immediately of any damage, shortage, discrepancy etc before they are moved out of the stores / storage area. The contractor shall be solely responsible for any shortages or damages in transit, handling, storage and erection of the equipment once received by him. As the erection work will be spread in different areas / locations of the project, contractor has to arrange sufficient number of watch / ward personal to avoid any pilferage of material |
| 6.1.9 | The contractor shall maintain an accurate and exhaustive record-detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the engineer at any time. |
| 6.1.10 | All the material in the custody of contractor and stored in the open or dusty locations must be covered with suitable weather proof / fire retardant covering material wherever applicable and shall be blocked up on raised level above ground. All covering materials including blocks and sleeper shall be arranged by the contractor at his cost. |
| 6.1.11 | If the material belonging to the contractor are stored in area other than those earmarked for his operation the engineer will have the right to get it moved to the area earmarked for the contractor at the contractors risk and cost. |
| 6.1.12 | The contractor shall be responsible for making suitable indoor storage facilities to store all equipment (drawn by the contractor from BHEL / customer stores), which require indoor storage till the time of their installation. The Engineer will direct the contractor in this regard, which item in his opinion will require indoor storage, and the contractor shall comply with Engineer's decision. |
| 6.1.13 | The contractor shall ensure that all surplus / damaged / scrap / unused material, packing wood / containers/ special transporting frames etc are returned to BHEL at a place in project area identified by the Engineer. The contractor will maintain an account for all items received and returned to BHEL. Any shortage in returning such items shall be chargeable to the contractor except allowable wastage for packing wood only. |
| 6.1.14 | The contractor shall hand over all parts / materials remaining extra over the normal requirement with proper identification tags to the stores as directed by |

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| | the concerned BHEL engineer. |
| 6.1.15 | The contractor shall ensure that all the packing materials and protective devices installed on equipment during transit and storage are removed before installation. |
| 6.1.16 | It shall be the responsibility of the contractor to keep the work / storage areas in neat, tidy and working conditions. All surplus/unusable packing and other materials shall be removed and deposited at location(s) specified by BHEL within the project premises. If required weighing of the same within the project premises will have to be carried out. |
| 6.2 | PRESERVATION OF COMPONENTS |
| 6.2.1 | After taking delivery from BHEL / customer's stores, plant materials storage shall be subjected to the following protection besides other provisions indicated in these specifications elsewhere. |
| 6.2.1.1 | Items stored outdoors shall be stacked up at least six inches (6") off the ground.Items should not be stored in a low lying area where water logging is a possibility. Contractor should have sufficient numbers of wooden / concrete / steel sleepers for the job. |
| 6.2.1.2 | Motors, valves, electrical equipment, control equipment and instruments, and special or precision items requiring special care,etc shall be stored indoors. Motor windings shall be kept dry by use of external heat or space heaters. |
| 6.2.1.3 | Bearings and other wearing surfaces of plant materials shall be protected against corrosion and kept clean and should be regularly monitored. |
| 6.2.1.4 | Insulation materials shall be stored indoors or otherwise protected against getting wet/ damaged, using suitable measures and should be protected from direct rain. |
| 6.2.2 | It shall be the responsibility of the contractor to apply preservatives / touch up paints (primer) on equipment handled and erected by him till such time of final painting. It shall be contractor's responsibility to arrange for required paints (primer), thinners, labour, scaffolding materials, cleaning materials like wire brush, emery sheets, etc, cleaning of surface and provide one coat of preservatives / paints (primer) from time to time as decided by BHEL engineer. The accepted rate shall include this work also. It is to be noted that such painting may have to be done as and when required till such time the final painting is carried out. |
| 6.2.3 | The contractor shall effectively protect the finished work from action of weather |

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| | and from damage or defacement and shall cover the finished parts then and there for their protection. |
| 6.2.4 | Any failure on the part of contractor to carry out works according to above clauses will entail BHEL to carry out the job from any other party and recover the cost from contractor. |

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| 7.0 | DRAWINGS AND DOCUMENTS |
| 7.1 | The detailed drawings, specifications available with BHEL engineers will be made available to the contractor during execution of work at site. The contractor will also ensure availability of all drawings / documents at work place. |
| 7.2 | Necessary drawings to carry out the erection work will be furnished to the contractor by BHEL on loan, which shall be returned to BHEL Engineer at site after completion of work. Contractor shall ensure safe storage and quick retrieval of these documents. |
| 7.3 | The contractor shall maintain a record of all drawings and documents available with him in a register as per format given by BHEL Engineer. Contractor shall ensure use of pertinent drawings / data / documents and removal of obsolete ones from work place and returning to BHEL. |
| 7.4 | The data furnished in various annexure enclosed with this tender specification are only approximate and for guidance. However, the change in the design and in the quantity may occur as is usual in any such large scale of work. The contractors quoted rates shall be inclusive of the above factor |
| 7.5 | Should any error or ambiguity be discovered in the specification or information the contractor shall forthwith bring the same to the notice of BHEL before commencement of work. BHEL's interpretation in such cases shall be final and binding on the contractor. |
| 7.6 | Deviation from design dimensions should not exceed permissible limit. The contractor shall not correct or alter any dimension / details, without specific approval of BHEL. |

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| 8.0 | INSPECTION AND QUALITY |
| 8.1 | Inspection, Quality Assurance, Quality Control |
| 8.1.1 | Preparation of quality assurance log sheets and protocols with customer/ consultants/statutory authority, welding logs, NDE records, testing & calibration records and other quality control and quality assurance documentation as per BHEL engineer's instructions, is within the scope of work/specification. These records shall be submitted to BHEL/customer for approval from time to time. |
| 8.1.2 | The protocols between contractor and customer/ BHEL shall be made prior to installation for correctness of foundations, materials, procedures, at each stage of installation, generally as per the requirement of customer/ BHEL. This is necessary to ensure elimination of errors or keeping them within tolerable limits and to avoid accumulation and multiplication of errors. |
| 8.1.3 | A daily log book should be maintained by every supervisor/engineer of contractor on the job in duplicate (one for BHEL and one for contractor) for detailing and incorporating alignment/clearance / centering / leveling readings and inspection details of various equipments etc.<br>High pressure welding details like serial number of weld joints, welders name, date of welding, details of repair, heat treatment etc. will be documented in welding log as per BHEL Engineer's instructions.<br>Record of radiography containing details like serial number of weld joints, date of radiography, repairs, if any, re-shots etc shall also be maintained as per BHEL Engineer's instructions.<br>Record of heat treatments performed shall be maintained as prescribed by BHEL |
| 8.1.4 | The performance of welders will be reviewed from time to time as per the BHEL standards. Welders' performance record shall be furnished periodically furnished for scrutiny of BHEL's Engineer. Corrective action as informed by BHEL shall be taken in respect of those welders not conforming to these standards. This may include removal/ discontinuance of concerned welder(s). Contractor shall arrange for the alternate welders immediately |
| 8.1.5 | All the welders shall carry identity cards as per the proforma prescribed by BHEL/Customer/Consultant. Only welders duly authorized by |

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| | BHEL/customer/consultant shall be engaged on the work. |
| 8.1.6 | Contractor shall provide all the Measuring Monitoring Equipments (MMEs) required for completion of the work satisfactorily. These MMEs shall be of brand, quality and accuracy specified by BHEL Engineer and should have necessary calibration and other certificates as per the requirement of BHEL Engineer. Decision of BHEL Engineer regarding acceptance or otherwise of the measuring instruments/gauges/tools for the work under this specification, is final and binding on the contractor. BHEL may give an indicative list of MMEs required for this work and to be made available by the contractor. The list will be reviewed by BHEL and the contractor shall meet any augmentation needed wherever required. |
| 8.1.7 | It is the responsibility of the contractor to prove the accuracy of the testing/measuring/calibrating equipments brought by him based on the periodicity of calibration as called for in the BHEL's quality assurance standards/BHEL Engineer's instructions. |
| 8.1.8 | Any re-laying or re-termination of cables/re-erection of instruments/ recalibration of instruments etc. required due to contractor's mistake or design requirement and found at any stage inspection, shall be carried out by the contractor at no extra cost. |
| 8.1.9 | BHEL, Power Sector Regions (PSNR/PSER/PSWR/PSSR) have already been accredited with ISO 9001 certification and as such this work is subject to various audits to meet ISO 9001 requirements. One particular aspect which needs special mention is about arrangement of calibration of instruments by the contractor. Contractor shallensure deployment of reliable andcalibratedMMEs (Measuring and Monitoring Equipments). The MMEs shall have test / calibration certificates from authorised / Government approved / Accredited agencies traceable to National / International Standards. Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer within the contract price. The contractor will also have alternate arrangements for such MMEs so that work does not suffer when the particular equipment / instrument is sent for calibration. Also if any MMEs not found fit for use, BHEL shall have the right to stop the use of such item and instruct the contractor to deploy proper item and recall ie repeat the readings taken by that instrument, failing which BHEL may deploy MME and retake the readings at Contractor's cost. |
| 8.1.10 | Re-work necessitated on account of use of invalid MMEs shall be entirely to the |

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| | contractor's account. He shall be responsible to take all corrective actions, including resource augmentation if any, as specified by BHEL to make-up for the loss of time. |
| 8.1.11 | In the courses of erection, it may become necessary to carry repeated checks of the work with instruments recently calibrated, re-calibrated. BHEL may counter/ finally check the measurements with their own MMEs. Contractor shall render all assistance in conduct of such counter/final measurements. |
| 8.1.12 | Total Quality is the watchword of the work and Contractor shall strive to achieve the Quality Standards, procedures laid down by BHEL. He shall follow all the instructions as per BHEL drawings and Quality Standards. |
| 8.2 | Stage Inspection By FES/QA Engineers |
| 8.2.1 | Apart from day-to-day inspection by BHEL Engineers stationed at Site and Customer's Engineers, stage inspection of equipments under erection and commissioning at various stages shall also be conducted by teams of Engineers from Field Engineering Services of BHEL's Manufacturing Units, Quality Assurance teams from Field Quality Assurance, Unit/Factory Quality Assurance and Commissioning Engineers from Technical Services etc. Contractor shall arrange all labour, tools and tackles etcalong with proper access for such stage inspections free of cost. |
| 8.2.2 | Any modifications suggested by BHEL FES and QA Engineers' team shall be carried out. Claims of contractor, if any, shall be dealt as per Section 13, and provided such modifications have not arisen for reasons attributable tothe contractor. |
| 8.3 | Statutory Inspection of Work |
| 8.3.1 | The work to be executed under these specifications has to be offered for inspection, at appropriate stages of work completion, to various statutory authorities for compliance with applicable regulations.<br>The work related statutory inspections, though not limited to, are as under:<br>1) Inspectorate of Steam Boilers and Smoke Nuisance<br>2) Electrical Inspector<br>3) Factory Inspector, Labour Commissioner, PF Commissioner and other authoritiy connected to this project work |

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| | The scope includes getting the approvals from the statutory authorities, which includes arranging for inspection visits of statutory authority periodically as per BHEL Engineer's instructions, arranging materials for ground inspection, taking rub outs for the pressure parts to be offered for inspection, submitting co-related inspection reports, documents, radiographs etc and following up the matter with them. Contractor shall also make all arrangements for offering the Products / Systems for inspection at location, as applicable, to the concerned authority. |
| 8.3.2 | Contractor should be qualified to execute pressure parts & piping work coming under the purview of IBR, for which he should register himself with CIB of state concerned. contractor also should be aware of the latest IBR regulations and Electricity Act, including the amendments thereof. |
| 8.3.3 | Contractor shall comply with 'Qualification Tests for welders engaged in welding of Boilers and Steam Pipes under Construction, Erection and Fabrication at Site in India and in repairing Boilers and steam pipes by welding' in line with Chapter XIII of Indian Boiler Regulations-1950, for testing his welders / men / workers, including all associated fees, procedures, required instruments and equipments and their calibration there of. It shall be contractor's responsibility to obtain approval of Statutory Authorities, wherever applicable, for the conducting of any work which comes under the purview of these authorities, at his cost. |
| 8.3.4 | The following fees shall be excluded from scope of Contractor:<br>1. Registration Fee as per Regulation 385 of Chapter IX of Indian Boiler Regulations-1950<br>2. Fees for inspection of Boiler at the site of Construction as per Regulation 395 A, sl no 4 of Chapter IX of Indian Boiler Regulations-1950<br>However all other fees like visit fees charged by the Boiler Inspector and other arrangements for his visit or visits till satisfactory completion of work, shall be included in scope of Contractor |
| 8.4 | The Quality Management System of BHEL, Power Sector Regions (PSNR/PSER/PSWR/PSSR) have already been certified and accredited under ISO 9002 standards in this regard. The basic philosophy of the Quality Management System is to define the organizational responsibility, work as per |

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| | documented procedures, verify the output with respect to acceptance norms, identify the non-conforming product/ procedure and take corrective action for removal of non-conformance specifying the steps for avoiding recurrence of such non-conformities, & maintain the relevant quality records. The nonconformities are to be identified through the conduct of periodical audit of implementation of quality systems at various locations/stages of work. Suppliers/vendors of various products/services contributing in the work are also considered as part of the quality management system. .as such the contractor is expected not only to conform to the quality management system of BHEL but also it is desirable that they themselves are accredited under any quality management system standard. |
| 8.5 | Field Quality Assurance |
| 8.5.1 | Contractor shall carry out all activities conforming to the approved Field Quality Plan (FQP) as revised from time to time. Total quality shall be the watchword of the work and contractor shall strive to achieve the quality standards, procedures laid down by BHEL. He shall follow all the instructions as per BHEL drawings and quality standards. Contractor shall provide the services of quality assurance engineer as per the relevant clauses. |

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| 9.0 | OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME:<br>BHEL, Power Sector Regions (PSNR/ER/WR/SR) are each certified for ISO 9001. Quality of work to customer's satisfaction and fulfillment of system requirements are the essence of ISO 9001 certification. BHEL, PS Regions have HSE certification (ISO 14001 & OHSAS 18001) and therefore Contractor also shall organise/ plan/ perform all their activities to meet with the applicable requirements of these standards. |
| 9.1 | HSE (Health, safety & Environment):<br>Contractor will comply with HSE (Health, safety & Environment) requirements of BHEL. HSE requirements in brief, are given below :- |
| 9.1.1 | Contractor will nominate one of their qualified and experienced employees as Safety Officer, who will be responsible for all HSE related issues of contractors work area. Safety Officer will have authority to stop any activity, in case he observes that the activity is not being carried out in safe manner. He will conduct surprise inspection as well as periodic inspection/drill (at least once in a month) and submit such reports to BHEL. He will conduct periodic meetings with supervisors of different working groups and explain HSE issues and use of PPEs to them. Reports of such meetings will be submitted to BHEL. Contractor will develop suitable work procedures based upon HSE guidelines and OCPs and implement it. Such work procedures will consist of Area of work, T&P Details, Work Procedure, PPE requirements etc. Please refer Schedule VIII of BOCW Rules for number of safety officers, qualification, duties etc.<br><br>Contractor should highlight the requirement of safety to staff and labour through daily tool box meeting before start of the days job.<br><br>Contractor to also submit monthly safety reports as per the format/procedure of BHEL. |
| 9.1.2 | The contractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by aregistered medical practitioner. The contractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job |
| 9.1.3 | Following personnel protective equipments (PPEs), in adequate numbers, will |

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| | be made available at site & their regular use by all concerned will be ensured :- |
| | - HELMET |
| | - SAFETY GOGGLES & WELDING FACE SHIELDS |
| | - SAFETY BELTS AND PROTECTIVE NET FOR WORKING AT HEIGHT |
| | - SAFETY SHOES |
| | - EAR PLUG |
| | - ANY OTHER SAFETY EQUIPMENT REQUIRED FOR SAFE COMPLETION OF THE WORK |
| | Contractor to also submit monthly reports on above as per the format/procedure of BHEL. |
| 9.1.4 | Providing appropriate First Aid facilities for prompt treatment of injuries and illness at work place. Arranging training to contractor workmen/ employees for giving first aid. |
| 9.1.5 | Arranging ambulance in case of any emergency situation . |
| 9.1.6 | Identification of nearest hospital and health check-up of workmen/employees |
| 9.1.7 | Providing filtered drinking water at work place in cool container. |
| 9.1.8 | Providing Canteen, Rest Room, Washing facilities to the contracted employees as per provisions of Contract Labour Regulation Act 1970 (Chapter V). |
| 9.1.9 | Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job. |
| 9.1.10 | Identification of nearest fire station and display contact telephone nos. / person's name around work places for cases of emergencies . |
| 9.1.11 | Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts. |
| 9.1.12 | Fulfilling safety requirements at all power tapping points. |
| 9.1.13 | Red & White caution tape of proper width(1.5 to 2 inch) to be used for cordoning unsafe area such as open trench, excavation area etc. |
| 9.1.14 | Providing contractors company logo on cloths /uniform/ proper identity cards with photographs, for correct identification of people working at project site . |
| 9.1.15 | High/ Low pressure welders to be identified with separate colourclothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place. |
| 9.1.16 | Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place . |

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| 9.1.17 | All scaffolding/ platforms should be made from materials of appropriate quality/grade so that these are safe for use. It should be certified/declared safe for use by an experienced contractor person, before any scaffolding/platform is used. Please refer IS:3696 part 1&2 and 4014 part 1 & 2 |
| 9.1.18 | All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL.. Contractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL. |
| 9.1.19 | Ensure that the regulatory requirement of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with. |
| 9.1.20 | Safety slogan, Safety/ Caution boards , wherever required to be displayed in consultation with BHEL. |
| 9.1.21 | Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained. Ensure proper cleanliness of work place, housekeeping and waste management (including proper waste disposal ) on daily basis. |
| 9.1.22 | It is imperative on the part of the contractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc. |
| 9.1.23 | The contractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure. |
| 9.1.24 | The Contractor is required to provide proper safety net systems (IS-11057) where ever the hazard of fall from height is present as per instruction of BHEL Engineer. The safety nets shall be fire resistant, duly tested and shall be of ISI Mark and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights. |
| 9.1.25 | All applicable OCPs (Operational control procedures) will be followed by contractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below . In case any other OCP is found to |

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| | be applicable during the execution of work at site, then contractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to contractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL at the Power Sector Regional HQ, or available in downloadable format in the website, which may be refereed by contractor, if they so desire. |
| | ■ OCP for safe handling of chemicals |
| | ■ OCP for Electrical safety |
| | ■ OCP for energy conservation |
| | ■ OCP for safe welding and gas cutting operation |
| | ■ OCP for fire safety |
| | ■ OCP for safety in use of hand tools |
| | ■ OCP for first aid |
| | ■ OCP for food safety at canteen |
| | ■ OCP for safety in use of cranes |
| | ■ OCP for storage and handing of gas cylinders |
| | ■ OCP for manual arc welding |
| | ■ OCP for safe use of helmets |
| | ■ OCP for good house keeping |
| | ■ OCP for working at height |
| | ■ OCP for safe excavation |
| | ■ OCP for safe filling of Hydrogen in cylinder |
| | ■ OCP for illumination |
| | ■ OCP for handling and erection of heavy metals |
| | ■ OCP for safe acid cleaning |
| | ■ OCP for safe alkali boil out |
| | ■ OCP for safe oil flushing |
| | ■ OCP for steam blowing |
| | ■ OCP for safe working in confined area |
| | ■ OCP for safe operation of passenger lift, material hoists & cages |
| | ■ OCP for Vehicle maintenance |
| | ■ OCP for safe radiography |
| | ■ OCP for waste disposal |
| | ■ OCP for working at night |
| | ■ OCP for blasting |
| | ■ OCP for DG Set |
| | ■ OCP for handling & storage of mineral wool |

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| | ■ OCP for drilling, reaming and grinding(machining) etc. |
| | ■ OCP for hydraulic test |
| | ■ OCP for spray insulation |
| | ■ OCP for trial run of rotary equipment |
| | ■ OCP for stress relieving |
| | ■ OCP for material preservation |
| | ■ OCP for cable laying/tray work |
| | ■ OCP for electrical maintenance |
| | ■ OCP for transformer charging |
| | ■ OCP for safe handling of battery system |
| | ■ OCP for computer operation |
| | ■ OCP for storage in open yard |
| | ■ OCP for sanitary maintenance |
| | ■ OCP for batching |
| | ■ OCP for piling rig operation |
| | ■ OCP for gas distribution test |
| | ■ OCP for cleaning of hotwell / deaerator |
| | ■ OCP for electro-resistance heating |
| | ■ OCP for compressor operation |
| | ■ OCP for O&M of control of AC plant & system |
| | ■ OCP for air compressor |
| | ■ OCP for passivation |
| | ■ OCP for Safe EDTA Cleaning |
| | ■ OCP for Safe Chemical cleaning of Pre boiler system |
| | ■ OCP for Safe Boiler Light up |
| | ■ OCP for Safe Rolling and Synchronisation |
| | ■ OCP for Safe Loading of Unit |
| 9.2 | SAFETY AND CLEANLINESS :<br>The contractor shall take all necessary safety precautions and arrange for appropriate appliances as per discretion of BHEL or its authorised officials (Site Construction Manager) to prevent loss of human lives, injuries, to personnel engaged and damage to property. Before commencing the work, the contractor shall submit a "Safety Plan" to the above authorised BHEL official and obtain approval on the same. The safety plan shall indicate in detail the measures that would be taken by the contractor to ensure safety of men, equipment, materials and environment during execution of the work. This will also include an organization structure, role and responsibilities of the concerned key |

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| | personnel, the safety practices that will be followed, PPEs deployed, plan for handling critical activities and emergencies. |
| 9.3 | If the contractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorised BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the contractor. |
| 9.4 | During the course of construction, alternation or repairs, scrap with protruding nail, sharp edge etc and all other debris shall be kept clean from working areas, passage, ways and stairs in and around site. |
| 9.5 | Combustible scrap and debris shall be removed at regular intervals during the course of execution. Safe means shall be provided to facilitate such removal. The combustible scrap should be stored in safe place away from the plant materials to avoid fire accidents. The area shall be chosen in consultation with the Engineer and to be cordoned off. |
| 9.6 | Rigging equipment for materials handling shall be inspected prior to use in each shift and as necessary during its use to ensure that it is safe. Defective rigging equipment will be removed from service. |
| 9.7 | Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment, when not in use, shall be removed from the original work area so as not to present a hazard to employees. |
| 9.8 | Contractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the contractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained. |
| 9.9 | Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the contractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The contractor shall be responsible for obtaining |

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| | the same. |
| 9.10 | Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently. |
| 9.11 | When cylinders are transported by powered vehicle they shall be secured in a vertical position. |
| 9.12 | All workmen of the contractor working on construction area shall wear safety shoes, hand gloves, safety helmets and safety belt as applicable. The contractor shall provide to its workforce and ensure the use of following personnel protective equipment as found necessary and as directed by BHEL. |
| 9.12.1 | Safety Helmets conforming to IS-2925 : 1984 |
| 9.12.2 | Safety Belts conforming to IS-3521:1983 |
| 9.12.3 | Safety Shoes conforming to IS-1989 : 1978 |
| 9.12.4 | Eye and face protection devices conforming to IS – 1179:1967, IS 5983:1980, IS 8521 Part 1:1977, IS 8521 Part 2: 1994. |
| 9.12.5 | Hand and body protection devices conforming to IS 4770:1991 and IS- 6994 : Part 1: 1973, IS – 8619 : 1977 |
| 9.12.6 | Ear protection IS-9167:1979 |
| 9.12.7 | Respiratory Protective Devices as per IS-9473:2002, i4746:1999 and 14166:1994 |
| 9.13 | The contractor shall insure his workmen against all accidents and the policy shall be presented to BHEL Engineer on demand. Other wise, BHEL will arrange the same and the expenditure towards this will be debited to the contractor. In case of a fatal or disabling injury accident to any person at construction site due to lapses by the contractor, the victim and/or his/her dependants shall be compensated by the contractor as per statutory requirements. However, if considered necessary BHEL shall have the right to impose appropriate financial penalty on contractor and recover the same from payments due to the contractor for suitably compensating the victim and/or his/her dependence before imposing any such penalty. Appropriate enquiry shall be held by BHEL giving opportunity to the contractor for presenting his case. Above safety conditions are not exhaustive but gives an idea for the contractor and contractor shall adhere to all safety precaution given by the |

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| | Engineer at site. |
| 9.14 | The contractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations during night hours at the work spot as well as at the pre-assembly area. |
| 9.15 | The contractor shall be responsible for provision of all the safety notices and safety equipment as enjoined on him by the application of relevant statutory regulation / provisions and/or as called upon by BHEL from time to time. He shall be held responsible for any violation of statutory regulations (local, state or central) and BHEL instruction that may endanger safety of men, equipment and material. |
| 9.16 | The contractor shall provide temporary fencing wherever required as a safety measure against accident and damage to properties. Suitable caution notices shall be displayed where access to any part is found to be unsafe and hazardous. |
| 9.17 | Contractor shall ensure safety of all the workmen, material and equipment either belonging to him or to others working at site. He shall observe safety rules and codes applied by BHEL without exception. |
| 9.18 | It will be the responsibility of the contractor to ensure safe lifting of the equipment, taking due precaution to avoid any accident and damage to other equipment and personnel. All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the contractor by engaging only the COMPETENT PERSONS as per law. Defective equipment or uncertifiedshall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load. |
| 9.19 | The contractor shall provide necessary first aid facilities as per schedule III. In addition, ambulance facilities, OHC and CMO as per schedule IV, V, X and XI of BOCW Rules as applicable for all his employees, representatives and workmen at site and BHEL shall have no obligation in this regard. The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time. The contractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency. |
| 9.20 | Training |

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| 9.20.1 | The contractor shall arrange induction safety training for all employees before assigning work. In addition, awareness programme, mock drill at regular intervals and daily tool box meetings shall be arranged. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats |
| 9.20.2 | All the contractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Contractor should nominate his supervisor to coordinate and implement the safety measures. |
| 9.21 | Contractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labour colony etc. Such fire protection equipment shall be easy and kept open at all times. The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders. All other fire safety measures as laid down in the "codes for fire safety at construction site" issued by safety coordinator of BHEL shall be followed. Non-compliance of the above requirement under fire protection shall in no way relieve the contractor of any of his responsibility and liabilities to fire accident occurring either to his materials or equipment or those of others. Emergency contacts nos must be displayed at prominent locations |
| 9.22 | The contractor shall at his cost, remove from vicinity of work at least once each day all combustible waste, scrap, panting materials, rubbish, unused or other materials and deposit them in places specified by BHEL to keep the work site clear and tidy. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed. |
| 9.23 | The contractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc. |
| 9.24 | All portable electric tools used by the contractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the contractor to carry out all types of electrical works. Details of earth resource ad their test date to be given to BHEL safety officer as per the prescribed formats of BHEL |
| 9.25 | In case of any delay in completion of a job due to mishaps attributable to lapses by the contractor, BHEL shall have the right to recover cost of such delay from |

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| | the payments due to the contractor, after notifying the contractor suitably. |
| 9.26 | Valve protection caps shall be kept in place and secured. |
| 9.27 | The contractor shall be responsible for the safe storage and handling of his radio-active sources as per BARC rules and regulations. |
| 9.28 | Tarpaulin being inflammable should not be used (instead, only non infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site. |
| 9.29 | If the contractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the contractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps at the risk and cost of the contractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL. |
| 9.30 | If the contractor succeeds in carrying out its job in time with out any fatal or disabling injury accident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the contractor suitably for the performance. |
| 9.31 | The contractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas. |
| 9.32 | The contractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site. BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the contractor. All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations. Area wise Electrical safety inspection is to be carried out on monthly basis as per “Electrical Safety Inspection checklist’ and the report is to be submitted to BHEL safety officer |
| 9.33 | The contractor shall arrange adequate number of persons specifically for clearing any debris and for house keeping of the erection area including restacking of components in the erection areas. Housekeeping to be carried out |

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| | as per BHEL's checklistand report is to be submitted to BHEL safety officer |
| 9.34 | In case of any damage to property due to lapses by the contractor, BHEL shall have the right to recover the cost of such damages from the contractor after holding an appropriate enquiry. |
| 9.35 | The contractor shall submit report of all accidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later then 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. In addition periodic reports on safety shall also be submitted by the contractor to BHEL from time to time as prescribed by the Engineer.Compiled monthly reports of all kinds of accidents, fires and property damage to be submitted to BHEL safety officer as per prescribed formats |
| 9.36 | Before commencing the work, the contractor shall appoint/nominate a responsible person to supervise implementation of all safety measures and liaison with his counterpart of BHEL. |
| 9.37 | Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders. When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper then ¼ horizontal and 1 vertical. |
| 9.38 | Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or otherwise secured, at least 90 cm above the floor or platform of such scaffolding or staging and extending along the entire length of the out side and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it form saver, from swaying, from the building or structure. |
| 9.39 | Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width which shall not be less than 750 mm and be suitably fenced as described above. |

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| 9.40 | Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm. |
| 9.41 | Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations. |
| 9.42 | Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app. 29.2 cm for ladder upto and including 3 m in length. For longer ladders this width shall be increased at least ¼'' for each additional foot of length. |
| 9.43 | A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction. |
| 9.44 | All personnel of the Contactor working within the plant site shall be provided with safety helmets. All welders shall wear welding goggles while doing welding work and all metal worker shall be provided with safety gloves. Persons employed on metal cutting and grinding shall wear safety glasses. |
| 9.45 | Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. |
| 9.46 | All trenches, four feet or more in depth, shall at all times be supplied with at least one ladder for each 30 m in length or fraction thereof. The ladder shall be extended from bottom of the trench to at least 90 cm above the surface of the ground. Sides of the trenches which are 1.50 m or more in depth shall be stepped back to give suitable slope or securely held by timer bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 m of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done. |
| 9.47.1 | The contractor shall take permission of BHEL prior to risky jobs such as working at height, hot work, liftig activities, etc through permits. No job should be started without permits. |
| 9.47.2 | The Contactor shall take all measures at the sites of the work to protect all persons from accidents and shall be bound to bear the expenses of defense of |

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| | every suit, action or other proceeding at law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the Contractor be paid to compromise any claim by any such person should such claim proceeding be filed against BHEL, the Contractor hereby agrees to indemnify BHEL against the same. |
| 9.48 | Before any demolition work is commenced and also during the process of the work the following shall be ensured: |
| 9.48.1 | All roads and open areas adjacent to the work site shall either be closed or suitably protected. |
| 9.48.2 | No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged. |
| 9.48.3 | All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe. |
| 9.49 | All necessary personnel safety equipment as considered adequate by the Engineer should be kept available for the use of the persons employed in the Site and maintained in a condition suitable for immediate use and the Contactor should take adequate steps to ensure proper use of equipment by those concerned. |
| 9.49.1 | Workers employed on mixing asphalted materials, cement and lime mortars shall be provided with protective foot wear and protective goggles. |
| 9.49.2 | Those engaged in white washing and mixing or stacking of cement bags or any materials which is injurious to the eyes shall be provided with protective goggles. |
| 9.49.3 | Those engaged in welding works shall be provided with welder's protective eyesight lids. |
| 9.49.4 | Stone breakers shall be provided with protective goggles and protective clothing and seated sufficient to safe intervals. |
| 9.49.5 | Where workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided |

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| | with warning signals or boards to prevent accident to the public. |
| 9.49.6 | The Contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precautions should be taken. |
| 9.49.6.1 | No paint containing lead or lead products shall be used except in the form of paste or ready made paint. |
| 9.49.6.2 | Suitably face masks should be supplied for use by the workers where paints are applied in the form of spray or a surface having lead paint dry rubbed and scrapped. |
| 9.49.6.3 | Overalls shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work. |
| 9.50 | When the work is being done near any place where there is risk of drowning all necessary equipment should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work. |
| 9.51 | Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe guards. Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers employed on electrical installations which are already energized, insulting mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided. The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity. |
| 9.52 | All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near the places of work. |
| 9.53 | The contractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test etc as applicable, to enable inspection Agency for performing Inspection. If any test equipment is found not complying with proper safety |

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| | requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met. |
| 9.54 | The Contractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard. BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the contractor shall adhere to such instructions. BHEL may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL. |
| 9.55 | All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764. |
| 9.56 | .All gas cylinders shall be stored in upright position. Suitable trolley shall be used. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced. No of cylinders shall not exceed the specified quantity as per OCP |
| 9.57 | These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent, place at work spot. The persons responsible for compliance of the safety code shall be named therein by the Contractor |
| 9.58 | To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangement made by the contract shall be open to inspection by the Engineer of the Engineer's Representative. |
| 9.59 | Keeping the work area clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the contractor. Such cleanings has to be done by contractor within quoted rate, on daily basis by an identified group. If such activity is not carried out by contractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost alongwith BHEL overheads will be deducted from contractor's bill. Such decisions of BHEL shall be binding on the contractor. |
| 9.60 | Notwithstanding the above clauses there is nothing to exit the Contractor from the operations of any other Act or Rule in force in area of work in this respect.<br>Provided always that all safety measures apart from those specifically provided in this agreement which are brought to the notice of the Contractor from time to time by the Engineer shall be complied by the Contractor. Provided further that |

all consequences, damages, or losses arising by reason of any safety code shall be met with by the Contractor.

9.61 NON COMPLIANCE:-

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE CONTRACTOR AS UNDER for every instance of violation noticed:

| SN | Violation of Safety Norms | Fine (in Rs) |
|---|---|---|
| 01 | Not Wearing Safety Helmet | 50/- * |
| 02. | Not wearing Safety Belt or not anchoring life line | 100/-* |
| 03 | Not wearing safety shoe | 100/-* |
| 04 | Not keeping gas cylinders vertically | 100/- |
| 05 | Not using flash back arrestors | 50/- |
| 06 | Not wearing gloves | 50/- * |
| 07. | Grinding Without Goggles | 50/- * |
| 08. | Not using 24 V Supply For Internal Work | 500/- |
| 09. | Electrical Plugs Not used for hand Machine | 100/- |
| 10. | Not Slinging property | 200/- |
| 11. | Using Damaged Sling | 200/- |
| 12. | Lifting Cylinders Without Cage | 500/- |
| 13. | Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property. | 200/- |
| 14. | Not Removing Small Scrap From Platforms | 200/- |
| 15. | Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting | 200/- |
| 16. | Not Maintaining Electric Winches Which are Operated Dangerously | 500/- |
| 17. | Improper Earthing Of Electrical T&P | 500/- |
| 18 | No or improper barricading | 500/- |
| 19. | Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case) | 1000/- |
| 20. | Accident Resulting in Partial Loss in Earning Capacity | 25,000/- per victim |

| | | | |
|---|---|---|---|
| | 21. | Fatal Accident/Accidents Resulting in total loss in Earning Capacity | 1,00,000/- per victim # |

Legend:-*: per head,
#: or as deducted by Customer whichever is higher

Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above. The amount will be deducted from running bills of the contractor. The amount collected above will be utilized for giving award to the employees who could avoid accident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.

9.61 CITATION:-If safety record of the contractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the contractor may be considered by BHEL after completion of the job

9.62 MEMORANDUM OF UNDERSTANDING

After Award Of Work, Contractors Are Required To Enter Into A Memorandum Of Understanding As Given Below:

Memorandum of Understanding

- BHEL, Power Sector _____ Region is committed to Health, Safety and Environment Policy (EHS Policy).
- M/s _____ do hereby also commit to the same EHS Policy while executing the Contract Number _____
- M/s _____ shall ensure that safe work practices not limited to the above are followed by all construction workers and supervisors. Spirit and content therein shall be reached to all workers and supervisors for compliance.
- BHEL will be carrying out EHS audits twice a year and M/s _____ shall ensure to close any non-conformity observed/reported within fifteen days.

Signed by authorized representative of M/s ----------

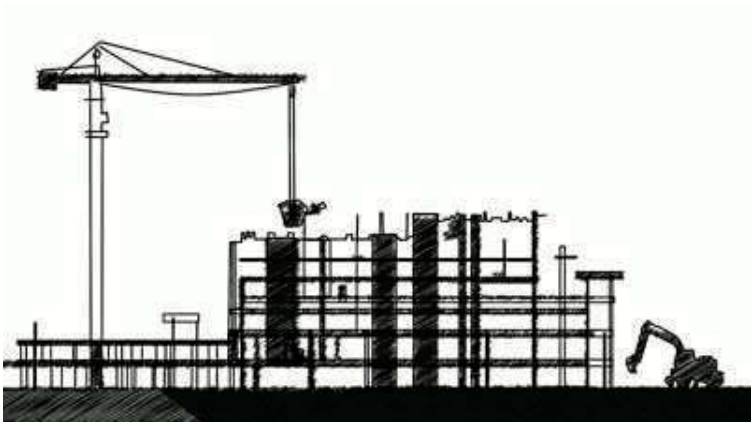
| | |
|---|---|
| | Name :<br><br>Place & Date: |

| | |
|---|---|
| 10.0 | RA Bill Payments |
| 10.1 | The contractor shall submit his monthly RA bills with all the details required by BHEL on specified date every month covering progress of work in all respects and areas for the previous calendar month. |
| 10.2 | Mode of payment and measurement of work completed shall be as per relevant clauses of General Conditions of Contract |
| 10.3 | Release of payment in each running bill including PVC Bills where ever applicable will be restricted to 95% of the value of work admitted as per stages of progressive pro rata payments. |
| 10.4 | The 5% thus remaining shall be treated as 'Retention Amount' and shall be released as per terms specified in the General Conditions of Contract. |
| 10.5 | The payment for running bills will normally be released within 30 days of submission of running bill complete in all respects with all documents. It is the responsibility of the contractor to make his own arrangements for making timely payments towards labour wages, statutory payments, outstanding dues etc and other dues in the meanwhile.<br><br>In case of Civil works, 60% of RA Bills complete and correct in all respects and certified by BHEL Engineer, shall be paid within 15 days of receipt. Balance payment shall be within 30 days. |
| 10.6 | BHEL shall release payment through Electronic Fund Transfer (EFT)/RTGS. In order to implement this system, Contractor to furnish details pertaining to his Bank Accounts where proceeds will be transferred through BHEL's banker, as per prescribed formats:<br><br>Note: BHEL may also choose to release payment by other alternative modes as applicable |
| 10.7 | Paying Authority shall be the Construction Manager of the Site. Any change in the paying Authority shall be intimated to the Contactor accordingly. |

| | |
|---|---|
| 11.0 | Performance Monitoring |
| 11.1 | Performance of the contractor is monitored through various reports/reviews and shall be jointly evaluated every month for unit wise identified packages as per prescribed formats. Based on the net weighted scores obtained, Contractors shall be rated 'Good' or 'Satisfactory' or 'Unsatisfactory' |
| 11.2 | In case of any dispute on performance rating and the contractor refuses to sign on the performance rating given by BHEL package Incharge, the same shall be reviewed by BHEL site Incharge/Construction Manager and his decision shall be final. |
| 11.3 | Release of RA Bills will be contingent upon joint evaluation of performance |
| 11.4 | Performance of the contractor will be taken into consideration for assessing the capacity of the bidder to execute future jobs under tender, as detailed in the Notice Inviting Tender. Risk of non evaluation or non availability of the Monthly performance evaluation reports is to be borne by the Bidder. |
| 11.5 | In case of 'Unsatisfactory performance' for a continuous period of three or more months for a package or packages, BHEL has the right to get the balance works executed at the risk and cost of the contractor. |
| 11.6 | In case of 'Unsatisfactory performance' in a financial year, BHEL reserves the right to put on hold such Contractors for a period of six months for similar package or similar packages |

| | |
|---|---|
| 12.0 | Suspension of Business dealings |
| 12.1 | BHEL reserves the right to take action against contractors who fail to perform or indulge in malpractices, by suspending business dealings with them. |
| 12.2 | Suspension could be in the form of 'Hold', 'De-listing' or 'Banning' a contractor. |
| 12.3 | A bidder may be put on HOLD for a period of 6 months, for future tenders for specific works on the basis of one or more of the following reasons:<br><br>a) Bidder does not honour his own offer or any of its conditions within the validity period.<br>b) Bidder fails to respond against three consecutive enquires of BHEL.<br>c) After placement of order, Bidder fails to execute a contract.<br>d) Bidder fails to settle sundry debt account, for which he is legitimately liable, within one year of its occurrence.<br>e) Bidder's performance rating falls below 60% in specific category (more fully described in chapter 'Performance Monitoring')<br>f) Bidder works are under strike/ lockout for a long period. |
| 12.4 | A Bidder may be de-listed from the list of registered Bidders of the region for a period of 1 year on the basis of one or more of the following reasons:-<br><br>a) Bidder tampers with tendering procedure affecting ordering process or commits any misconduct which is contrary to business ethics.<br>b) Bidder has substituted, damaged, failed to return, short returned or unauthorizedly disposedoff materials/ documents/ drawings/ tools etc of BHEL.<br>c) Bidder no longer has the technical staff, equipment, financial resources etc. required to execute the orders/ contracts. |
| 12.5 | A Bidder can be banned from doing any business with all Units of BHEL for a period of 3 years on the basis of one or more of the following reasons:<br>a) Bidder is found to be responsible for submitting fake/ false/ forged documents, certificates, or information prejudicial to BHEL's interest.<br>b) In spite of warnings, the Bidder persistently violates or circumvents the provisions of labour laws/ regulations/ rules and other statutory requirements.<br>c) Bidder is found to be involved in cartel formation |

| | |
|---|---|
| | d) The Bidder has indulged in malpractices or misconduct such as bribery, corruption and fraud, pilferage etc which are contrary to business ethics.<br>e) The Bidder is found guilty by any court of law for criminal activity/ offences involving moral turpitude in relation to business dealings.<br>f) The Bidder is declared bankrupt, insolvent, has wound up or been dissolved; i.e ceases to exist for all practical purposes.<br>g) Bidder is found to have obtained Official Company information/ documentation by questionable means.<br>h) Communication is received from the administrative Ministry of BHEL to ban the Bidder from business dealings. |
| 12.6 | Contracts already entered with a contractor before the date of issue of order of 'HOLD' or 'DE-LISTING' shall not be affected. |
| 12.7 | All existing contracts with a 'BANNED' contractor shall normally be short closed |
| 12.8 | Once the order for suspension is passed, existing offers/new offers of the contractor shall not be entertained |
| 12.9 | The above guidelines are not exhaustive but enunciate broad principles governing action against contractors |



# HEALTH, SAFETY and ENVIRONMENT PLAN

**For**

**SITE OPERATIONS**

**By**

**SUB-CONTRACTORS**

**POWER SECTOR- EASTERN REGION**

# DOCUMENT ISSUE SHEET

| | PREPARED BY | APPROVED BY |
|---|---|---|
| **NAME** | TASK FORCE | |
| **DESIGNATION** | | |
| **SIGNATURE** | | Pradip Ghosh<br>Digitally signed by Pradip Ghosh<br>DN: cn=Pradip Ghosh, o=BHEL, ou=HSE-PSER, email=pradipg@bhelpser.co.in, c=IN<br>Date: 2019.05.14 16:49:41 +05'30' |
| **ISSUED BY:** | | |
| **ISSUED TO:** | | |
| **COPY NO:** | | |
| **DATE OF ISSUE:** | | |
| | | |

**THIS PLAN SUPERSEDES THE STANDARD HSE PLAN**

## HSE PLAN FOR SITE OPRATIONS BY BHEL'S SUBCONTRACTORS AT A GLANCE

**BEFORE START**

| SIGNING OF MOU | |
|---|---|
| Agree to comply to HSE requirement- Statutory and BHEL's | Agree to accept BHEL's decision on release of 1.5% (as specified in the contract) of Gross bill Amount or part thereof or otherwise (non-release), based on our HSE performance as evaluated by BHEL during the execution period |

**PLAN**

| HSE ORGANISATION | |
|---|---|
| **Manpower**<br>• **1 (one) safety officer for every 300 workers or part thereof**<br>• **1(one) safety-supervisor for every 150 workers**<br>• **1(one) safety-steward/ supervisor for every 50 workers**<br>As per Cl. 7.1 | **HSE Roles and responsibilities**<br>• All employees as per 7.2.1<br>• Site In-charge & Package In-charges- As per clause 7.2.2<br>• Safety officer- As per clause 7.2.3 |

**HSE Planning**
for Man, Machinery / Equipment/ Tools & Tackles

**PROVIDE**

| HSE INFRASTUCTURE | |
|---|---|
| • PPEs<br>• Drinking Water<br>• Washing Facilities<br>• Latrines and Urinals<br>• Provision of shelter for rest<br>• Medical facilities | • Canteen facilities<br>• Labor Colony<br>• Emergency Vehicle<br>• Pest Control<br>• Scrapyard<br>• Illumination<br>• Crèches (if required) |

**TRAIN**

| HSE TRAINING , AWARENESS & PROMOTION | |
|---|---|
| **Training**<br>• Induction training<br>• Height work and other critical areas<br>• Tool Box talk & Pep Talk<br>• Job Specific Training | **Awareness & Promotion**<br>• Posters & Signage<br>• Emergency Contact/Information Display<br>• Banner<br>• Competition & Awards |

**COMMUNICATE**

| HSE COMMUNICATION | |
|---|---|
| **Incident Reporting**<br>• Accident- Fatal, Major & Minor<br>• Property damage<br>• Near Miss<br>**Safety Performance Reporting** | **Event Reporting**<br>• Celebrations<br>• Training<br>• Medical camp<br>• Motivational Activities |

EXECUTE SAFELY

## SAFETY DURING WORK EXECUTION

**PERMIT TO WORK**

Height work (above 2 meters), Hot Work, Heavy Lifting, Confined Space, Radiography, Excavation (More than 1.22 meters), Lockout / Tag out

**OPERATIONAL CONTROL**

- Welding, Gas Cutting Grinding
- Rigging, Signaling
- Cylinder- Storage & Movement
- Demolition work
- T&Ps
- Chemical Handling
- Electrical works
- Painting
- Fire
- Scaffolding
- Height work
- Working Platform
- Excavation / Civil Work
- Ladder
- Lifting
- Hoisting appliance
- Hard Barricading

**HOUSE KEEPING**

**WASTE MANGEMENT**

**TRAFFIC MANAGEMENT**

**ENVIRONMENTAL CONTROL**

**EMERGENCY PREPAREDNESS AND RESPONSE PLANNING**

CHECKS

**HSE AUDITS & INSPECTION**

- Daily Checks
- Inspection of Height work
- Inspection of PPEs
- Inspection of T & Ps
- Inspection of Cranes & Winches
- Inspection of Welding and Gas cutting
- Inspection of elevators etc.

**HSE PERFORMANCE EVALUATION PARAMETERS**

NON CONFORMANCE

**PENALTY for NON CONFORMANCE**
**Refer Clause 16 Incremental penalty**

For repeated violation by the same person, the penalty would be double of the previous penalty

For repeated fatal incident in the same contract / package, incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to the previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

**COMPENSATION TO ACCIDENT VICTIMS**
**Refer Clause 17**
**Employee Compensation Act, 1922**
**Other Acts and Guidelines relevant to employee compensation**

## ORGANIZATION OF THIS DOCUMENT

- ***GENERAL SECTION***

- ***SECTION A:***

  MAIN REQUIREMENTS APPLICABLE IN FULL

- ***SECTION B:***

  SPECIAL REQUIREMENTS

- ***ANNEXES***

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# GENERAL

## 1. PURPOSE

**1.0** The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.

**1.1** This document shall be followed by BHEL's Sub-Contractors at all installation and servicing sites. In case BHEL has contractual HSE obligations towards customer, this document will be followed in conjunction with (BHEL's) customer specific requirements, ensuring that applicable systems, controls and checks of both are implemented in letter and spirit.

**1.2** In case the customer has any specific requirement, the same is to be fulfilled but may not include financial inclusion.

**1.3** This document shall be followed unless otherwise mentioned in TCC (technical condition of contract) or elsewhere in NIT or contract documents. This supersedes all HSE clauses in GCC.

**1.4** Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed.

## 2. SCOPE

The document is applicable on all activities and assets including managerial, supervisory, professional, technical, clerical and other workers including contract laborers; and equipment operating under the control of BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

## 3. OBJECTIVES

The HSE Plan reflects that BHEL places high priority upon the Occupational Health, Safety and Environment at workplaces. The Sub-contractor shall:

***Health & Safety***

- Prevent injury and ill health of all persons at site ('Persons' refers to all personnel including managerial, supervisory, professional, technical, clerical and other workers including contract laborers)

***Environment***

- Prevent pollution to environment and ensure protection of environment taking into account interested party concern and conservation of resources and reduction of wastage

***Legal Requirements***

- Comply at all times with the relevant statutory and contractual HSE requirements.

***Planning & Resources***

- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.

***Competency, Training & Awareness***

- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.

***Maintenance of Equipment***

- Ensure fitness testing of all T&Ps. Lifting appliances like cranes, chain pulley blocks etc. are certified by competent authority.

***Safety during Operations***

- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- Establish effective communication on HSE matters with all relevant parties involved in the Project works.

***HSE Improvement***

- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause
- Ensure timely implementation of correction, corrective action.
- Ensure continual improvement in HSE performance
-

## GOALS AND TARGETS

- **To achieve "Zero Incident at Site" (LTI)**
- **100% compliance of all legal/statutory requirements related to HSE.**
- **100% Health, Safety and Environmental Induction training attendance for all workers.**
- **100% High Risk activities to be carried out only after approved Method Statement, HIRA / Aspect-Impact / JSA / OCP and Permit to Work are implemented.**
- **100% PPEs compliance in high and medium risk activities.**
- **100% monitoring of all Work Areas**
- **100% detection of non-conformities in work area and 100% closure within specified time**
- **100% incident (near miss, minor, major, other) reporting, recording and reviewing for corrective actions.**
- **Regular Safety Reviews to assess HSE program compliance and 100% closure of any recognized gaps to continually improve safety management and incident prevention.**

## *4. REFERENCES*

1. ALL CONTRACTUAL HSE REQUIREMENTS INCLUDING THIS DOCUMENT
2. ALL APPLICABLE ACTS, RULES & REGULATIONS
3. BHEL POWER SECTOR HSE MANAGEMENT SYSTEM
   - I. HSE PROCEDURES (13.1.1)
   - II. WORK PERMITS (See Clause 13.1.2)
   - III. OPERATIONAL CONTROL PROCEDURES (See Clause 13.1.3)
   - IV. FORMATS (See Clause 21)
4. BHEL CORPORATE STANDARD PPE GUIDELINES
5. RELEVANT INDIAN STANDARDS FOR SAFETY (See Annexure 02)

**(Note: Wherever, the date or revision number of a document is not mentioned, latest revision is implied)**

## 5. BHEL HEALTH, SAFETY & ENVIRONMENT POLICY:

In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

Atul Sobti
Chairman & Managing Director

## 6. TERMS AND DEFINITIONS

### 6.0 INCIDENT

Work- related or natural event(s) in which an injury or ill health (regardless of severity) or fatality, damage to property/environment occurred, or could have occurred.

### 6.1 NEAR MISS

An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as “Near-Miss incident”.

### 6.2 MAN-HOURS WORKED

The total number of employee hours worked by all employees including subcontractors working in the premises.
It includes managerial, supervisory, professional, technical, clerical and other workers including contract laborers.
Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the period covered by the number of hours worked per day. The total number of workday for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

### 6.3 FIRST AID CASES

First aid cases include:

1. Visit to a physician or a licensed health care professional solely for observation or counselling
2. Conduct of diagnostic procedures like X rays, blood test including the prescription medications used solely for diagnostic purposes (e.g. eye drops to dilate eyes)
3. Using a non-prescription medicine at non-prescription strength (for medication available in both prescription and non-prescription form as recommendation by a physician or other licensed health care professional to use a non-prescription medication at prescription strength is considered medical treatment for record keeping purposes};
4. Administering tetanus immunizations (other immunizations, such as Hepatitis B vaccine or rabies vaccine, are considered medical treatment);
5. Cleaning, flushing or soaking wounds on the surface of the skin;
6. Using wound coverings such as bandages, Band-Aids TM, gauze pads, etc.; or using butterfly bandages or Steri-Strips TM (other wound closing devices such as sutures, staples, etc., are considered medical treatment);
7. Using hot or cold therapy;
8. Using any non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc. (devices with rigid stays or other systems designed to immobilize parts of the body are considered medical treatment for record-keeping purposes);

9. Using temporary immobilization devices while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.).
10. Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;
11. Using eye patches;
12. Removing foreign bodies from the eye using only irrigation or a cotton swab;
13. Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;
14. Using finger guards;
15. Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes); or
16. Drinking fluids for relief of heat stress.

No other treatments are considered first aid.

## 6.4 MEDICAL TREATMENT CASES

An incident involved with an injury or illness that needs medical attention beyond First-aid as per 6.3 above.

## 6.5 TYPE OF INCIDENT / ACCIDENT & THEIR REPORTING:

The categories of Incident / accident are as follows:

**Non-Reportable Cases:**

An accident, where the injured person is given first aid and discharged for work without counting any lost time.

**Reportable Cases (LTI or Loss Time Injury Cases):**

**Minor:** In this case the injured person resumes duty within 48 hours of incident

**Major:** In this case the injured person is disable for 48 hours or more and is not able to perform his duty. (as per IS 3786)

## 6.6 TOTAL REPORTABLE FREQUENCY RATE

Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

$$\frac{\text{Number of Reportable LTI}}{\text{Man Hours Worked}} \times 1{,}000{,}000 \text{ Total}$$

## 6.7 SEVERITY RATE

Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:

$$\frac{\text{Days lost due to LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

## 6.8 FREQUENCY SEVERITY INDEX (FSI)

Frequency Severity Index, FSI =√ FR*SR/1000

## 6.9 INCIDENCE RATE

Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:

$$\frac{\text{Number of LTI} \times 1000}{\text{Average number of manpower deployed}}$$

## 6.10 JOB SAFETY ANALYSIS

A job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job operation. In a JSA, each basic step of the job is to identify potential hazards and to recommend the safest way to do the job. Other terms used to describe this procedure are job hazard analysis (JHA) and job hazard breakdown.

## 6.11 SAFETY WALK

It's a walk (conducted periodically) by an official through a portion or whole of a site as an HSE officer, noting down HSE observations, speaking to concerned workmen and supervisor on observation, recording and reporting to in charges of agencies, getting the same rectified with personal follow up - to send out a strong message on Management's commitment to safety.

## 6.12 HEAVY & COMPLEX LIFTING

**A** heavy and complex lifting activity includes:

1. Lifting above 50 Tons
2. Tandem Lifting using multiple cranes
3. Total load exceeding 75% of capacity of crane
4. Lift of unusual difficulty or geometry or rigging
5. Lift over operating units
6. Any other lift as decided by site HSE / Erection

In any case, Job Safety Analysis to be carried out for any lift above 5 Tons.

## 6.13 SAFETY COMMITTEE

As per the BOCW, Safety Committee shall be constituted if there are more than five hundred or more construction workers are employed at any site. As per the Factories Act, 1948 it is for 250 workers. It shall be represented by equal number of representatives of employer and construction workers.

## 6.14 NIGHT WORK

Work conducted after sunset when only a fraction of total manpower is available

Section-A

# *Main Requirements*

*(Applicable in Full)*

## *7. HSE ORGANISATION*

### 7.1 DEPLOYMENT

#### 7.1.1 Minimum Number (Availability per contract / package per Working Shift)

| 7.1.1.1 HSE Officer | 7.1.1.2 HSE Supervisor | 7.1.1.3 HSE Steward / Observer |
|---|---|---|
| 1 per 300 workers or part thereof as a minimum or as mandated by applicable legal requirements, whichever more stringent | 1 per 150 workers or part thereof | 1 per 50 workers or part thereof |

7.1.1.4 The safety officers shall be engaged directly by the sub-contractor, whereas safety supervisors and safety stewards may be from the agencies engaged by the sub-contractor.

**7.1.1.5 Deployment Plan:**

7.1.1.5.1 These shall be minimum one HSE officer along with HSE supervisor and HSE steward in the aforesaid ratio for every shift for each unit of Boiler/ESP/Power House & TG/ Chimney/ Whole of Cooling Tower.

7.1.1.5.2 For Civil works and other BOP items, deployment shall be broadly as specified in the above table. But BHEL shall finally approve the deployment based on nature and volume of jobs, Risks and hazards associated etc.

7.1.1.5.3 The deployment plan of Safety manpower at various locations shall be submitted to BHEL for approval by subcontractor

BHEL reserves the right to demand more safety personnel than what is stipulated here and change the deployment pattern

### 7.1.2 QUALIFICATION & EXPERIENCE

**All Degrees/ Diplomas shall be recognized by State Council for Technical Education & Vocational Training (SCTE & VT) / All India Council for Technical Education (AICTE) / University**

| 7.1.2.1 HSE Officer | 7.1.2.2 HSE Supervisor | 7.1.2.3 HSE Steward / Observer |
|---|---|---|
| **A.**<br>i. Recognized degree in any branch of Engg. or Tech. or Architecture with practical experience of working in a building or other construction work in supervisory capacity for a period of not less than two years,<br>or<br>Recognized diploma in any branch of Engg. or Tech with practical experience of working in a building or other construction work in supervisory capacity for a period of not less than five years.<br>ii. Recognized degree or diploma in Industrial safety<br>ii. (Preferably) have adequate knowledge of the language spoken by majority of the workers at the construction site.<br>**Alternatively:**<br>**B.**<br>Graduation Degree in Science with Physics & Chemistry and degree or diploma in Industrial Safety (from any Indian institutes recognized by AICTE or State Council of Tech. Education of any Indian State) with practical experience of working in a building, plant or other construction works (as Safety Officer, in line with Indian Factories Act, 1958) for a period of not less than five years. | As a minimum, (s)he shall possess:<br><br>A recognized graduation Degree in Science (with Physics & Chemistry) or a recognized diploma in Engg. or Tech. with:<br><br>a. Minimum Two years of practical experience in construction work environment and<br><br>b. Should possess requisite skills to deal with construction safety & fire related day-to-day issues. | As a minimum, (s)he shall possess:<br>1. Class XII pass certificate and<br>2. Trained in fire-fighting as well as in safety / occupational health related subjects, with:<br>a. Minimum two year of practical experience in construction work environment and<br><br>b. Should have adequate knowledge of the local language spoken by majority of the workers at the construction site. |

### 7.1.3 HSE IN-CHARGE

In case there are more than one HSE Officers with any subcontractor, one of them, who is senior most by experience (in HSE discipline), may be designated a s HSE In-Charge. Duties & responsibilities of such person shall be commensurate with that of relevant statute and primarily to coordinate with top management of Client and subcontractors.

### 7.1.4 AVAILABILITY AND PENALTY FOR NON-DEPLOYMENT:

Subcontractor shall ensure physical availability of safety personnel at the place of specific work location including where Height Work Permit is required/granted. No work shall be started in any area until above safety personnel & concerned Site Engineer of subcontractor are physically deployed at site.
The Subcontractor shall prepare an organization chart identifying the areas of operations, responsibilities and reporting structure of all safety personnel and submit the same to BHEL.

The subcontractor shall deploy sufficient safety officers, supervisors and safety-stewards, as per numbers & qualifications mandated in this Section since mobilization of first batch of manpower and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty at following rates:

| | | |
|---|---|---|
| Non-deployment of HSE Officer | – | **Rs 50000 per man-month** |
| Non-deployment of HSE Supervisor | – | **Rs 30000 per man-month** |
| Non-deployment of HSE Steward | – | **Rs 20000 per man-month** |

Penalty shall be collected for the period of non-availability of safety personnel after allowing a grace period of 15 days for finding a replacement.

### 7.1.5 QUALIFICATION OF CRANE & WINCH OPERATORS, DRIVERS etc.:

The Crane and Winch Operators, Drivers, Riggers and other professionals deployed shall be qualified and experienced, and have valid license for the class of vehicle / machinery as applicable. The sub-contractor shall certify competence of these persons.in writing as and when they join.
Crane/Winch operator should have certificate on subject course or owner experience certificate in letterhead.

7.1.6 In case the statutory requirements i.e. State or Central Acts and / or Rules as applicable like the Building and Other Construction Workers' Regulation of Employment and Conditions of Service- Act,1996 or State Rules (wherever notified), the Factories Act, 1948 or Rules (wherever notified), etc. are more stringent than above clarifications, the same shall be followed.

7.1.7 **BILLING:** Deployment of Safety manpower as per this clause **shall be** a billable item.

7.1.8 The Subcontractor shall verify & authenticate credentials of the HSE personnel detailed in this Section and furnish Bio-Data/Resume / Curriculum Vitae of the safety personnel as above for BHEL / Owner's approval, at least 1 month before the mobilization. The Subcontractor, whenever required, shall arrange submission of original testimonials / certificates of their Safety personnel, to BHEL / Owner (for verification/scrutiny, etc.)

7.1.9 Prior approval of CVs by BHEL for Safety Officer and Safety Supervisor is mandatory, however BHEL has right to check suitability of Safety Stewards as well.

## 7.2 HSE RESPONSIBILITIES

The subcontractors shall communicate the HSE responsibilities as indicated in this section to relevant employees in written Form and ensure awareness of the same

### 7.2.1 ALL EMPLOYEES

1. To be aware of, get involved in and ensure implementation of all HSE related Systems and Procedures including but not limited to:

    a) BHEL HSE Management System including HSE Procedures and OCPs
    b) Work Permit System
    c) Emergency Preparedness Response Plans
    d) Contractual HSE requirements
    e) Legal Requirements
    f) Penalty System
    g) Training requirements
2. To ensure that the persons engaged in respective area follow the safety rules like using appropriate PPEs.
3. To keep track of repetitive minor or major incident observation/ report and submit to BHEL.
4. To prepare HIRA / JSA as required and submit to BHEL for verification.
5. To record all incidents including near miss and report to BHEL.
6. To adopt safe working practices at all times and act as role model for Safety
7. To take immediate corrective action actions in case any non-conformity is observed on product / process / system with respect to Occupational Health, Safety and Environment.
8. In case any particular activity / work has extremely high consequential risk or high environmental impact, same shall be brought to the notice of BHEL Package In-charge before starting the work.
9. To interfere/ stop work as & when identified unsafe.
10. To maintain & promote improved level of house-keeping all the time at site.
11. To support/co-operate with audit team members as & when safety audits are carried out.
12. To involve in investigation, if any incident occurs in his work area.
13. To participate in safety promotional programmes.
14. To attend the safety committee meeting, if member/ invitee
15. To ensure that only fit T&Ps and qualified persons are engaged for all activities.
16. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
17. Shall ensure that materials are not thrown from height. Cautions to be exercised to

prevent fall of material from height.

18. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent authorities.

### 7.2.2 SITE IN –CHARGE & PACKAGE IN-CHARGES OF SUBCONTRACTOR

1. All requirements as per 7.2.1
2. **Shall ensure fulfillment of HSE requirements of BHEL contract as given in this document.**
3. Shall engage qualified safety manpower as per this document at all times.
4. Shall adhere to the rules and regulations mentioned in this document, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
5. Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
6. Shall ensure that all the workers are engaged after undergoing induction training.
7. Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men /women carry excessive weight more than stipulated in Factory Rule Regulation R57.
8. Shall ensure that provisions stipulated in contract Labor Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
9. Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
10. Shall conduct Safety Walks and safety inspections, and act as a role model for Safety.
11. Shall ensure that Horseplay is strictly forbidden.
12. Shall ensure that adequate illumination is arranged during night work.
13. Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
14. Shall ensure display of adequate signage/posters on HSE.
15. Shall ensure that mobile phone is not used by workers while working.
16. Shall ensure conductance of HSE audit, mock drill, medical camps, induction training and training on HSE at site.
17. Shall ensure full co-operation during Client/External /Customer HSE audits.
18. Shall ensure submission of look-ahead plan for procurement of HSE equipment’s and PPEs as per work schedule.
19. Shall ensure adequate valid fire extinguishers are provided at the work site.
20. Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labor colony.
21. Shall ensure adequate emergency preparedness
22. Site In-charge also involve in the induction training so as to share knowledge of some incident and guide the worker to perform work safely.
23. Shall ensure power source for hand lamps shall be maximum of 24 v.
24. Shall ensure temporary fencing should be done for open edges if Hand – railings and Toe-

guards are not available.

25. Shall be responsible for the periodic testing of T&Ps (winches / crane /hydra/tools/equipment so on.) and Pressure Vessels as per applicable codes and submit report to BHEL
26. Shall be member of site HSE committee and attend all meetings of the committee

### 7.2.3 HSE OFFICER OF SUBCONTRACTOR

1. All requirements as per 7.2.1
2. Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
3. Facilitate HIRA and Aspect/Impact Study in the area and ensure control measures.
4. Highlight the requirements of safety through Tool-box / other meetings.
5. Help concerned HOS to prepare Job Specific instructions for critical jobs.
6. Maintain record and conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
7. Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
8. Convene HSE meeting & minute the proceeding for circulation & follow-up action.
9. Plan procurement of PPE & Safety devices and inspect their healthiness.
10. Report to BHEL on all matters pertaining to status of safety and promotional programmes at site level.
11. Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
12. Facilitate administration of First Aid
13. Facilitate screening of workmen and safety induction.
14. Conduct fire Drill and facilitate emergency preparedness
15. Design campaigns, competitions & other special programs to promote safety in the workplace.
16. Notify non-conformance to safety norms observed during site visits / site inspections.
17. Recommend to Site In-charge, immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
18. To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.

### 7.2.4 HSE SUPERVISOR OF SUBCONTRACTOR

1. All requirements as per 7.2.1
2. To assist Safety officer

### 7.2.5 HSE STEWARD / OBSERVER OF SUBCONTRACTOR

1. All requirements as per 7.2.1
2. To monitor allotted area for Safety violations, take required action and inform the concerned Safety Supervisor / Officer

3. To assist Safety Officer and Safety Supervisor

### 7.2.6 HSE DOCUMENTS, SYSTEMS & PROCEDURES:

BHEL shall provide the subcontractor soft copies of all applicable HSE Procedures, Work Permits, Operational Control Procedures, Formats and any other instructions required for the implementation of HSE Management System before commencing operations at site. Subcontractor shall ensure the availability of the same.

### 7.2.7 IMPORTANT SITE EHS RULES RESULTING IN POSSIBLE EXPULSION FROM SITE

- Pre-employment Medical fitness is compulsory for all workers.
- EHS induction in mandatory for all new workers, supervisor and engineers, subcontractor managers etc.
- No visitors are allowed for site visit without safety induction.
- **Mandatory PPEs are**
  - ✓ *Safety helmet,*
  - ✓ *Hard toe safety shoes,*
  - ✓ *Safety glasses*
  - ✓ *Reflective vest*
  - ✓ *Full/half sleeve (at least 4-inch-long) shirt*
  - ✓ *Full length pant/trousers for male and preferably Salwar Kameez for female*
- **Zero Tolerance Safety Rules**
  - Violation of Fall protection / not anchoring & wearing safety harness above 6 feet,
  - Work without PTW
  - Child labor at site
- Restricted Use of cell phone in the working zone, operating vehicle/crane and at height. Encourage the people not to bring mobile phones inside the project premises.
- All vehicle being used at site to be in good condition in all respect.
- All electrical installations should have individual 30 mA ELCBs
- **Fighting**: Fighting anywhere on the Project site, including in parking areas, is strictly forbidden; violators will be barred from site and possibly subjected to legal action by local authorities.
- **Horseplay**: Running, pushing, practical jokes, and other horseplay are forbidden on the project site, including in parking areas.
- **Gambling**: Gambling on the Project site is not permitted
- **Alcohol & Drugs**: Intoxication or possession of alcohol or illegal drugs is strictly forbidden.
- **Weapons**: Possession of weapons on the Project site is strictly prohibited
- **Asbestos Material**: No asbestos material is allowed to use in Project Site
- **Hair**: Anyone working on site property with scalp hair longer than the top of his/her shoulders must tie-up and restrains the hair within the hard hat or coveralls, shirt or jacket collar.
- **Jewelry**: Loose necklaces, dangling earrings and bracelets shall not be worn when working on the Project site.

- **Contact Lens**: While the site does not prohibit the wearing of contact lens, BHEL Project does not recommend their use.

- **Use of Empty Drums**: Use of empty drums to climb up and work is banned. Proper stool/ ladder/ stage required to be used if intended to work at height.
- Projects must comply in full with all applicable EHS local and national legislation. In circumstances where there is a conflict between local or national legislation and client requirements, the higher (more protective) requirement must prevail.
- All persons working on suspended scaffolds/cradles/gondolas must wear and use appropriate fall prevention equipment so as to protect them effectively at all times when they are at risk from any failure of any part of the scaffold/cradle/gondola, including its suspension system

- **Construction Trucks/Vehicles**

  - ✓ Vehicles must be equipped with proper seat belts for driver and passengers. All persons riding in vehicles must be advised of the requirement that seat belts are to be used whenever the vehicles are being operated.
  - ✓ The subcontractor is responsible for assuring the overall safe condition of vehicles assigned to its projects.
  - ✓ The speed limit on the project site is a maximum of 20 Km/hr.
  - ✓ Any person found operating or driving in a reckless or careless manner without regard for the safety of other employees or the general public will be immediately removed for the equipment they were operating and permanently prohibited from operating or driving any equipment on the project.
  - ✓ Any mobile equipment found to be unsafe or defective must be immediately removed from service and sent for repair or replacement. The subcontractor must ensure that the proper repairs have been made prior to putting the equipment back into service.

- **Construction Material Handling Heavy Equipment**

  - ✓ No equipment may be modified without equipment manufacturer's authorization.
  - ✓ Rollover Protective Structures must be provided for all equipment as required.
  - ✓ Seat belts must be provided and used by operators of all equipment that has a Rollover Protective Structure.
  - ✓ All bi-directional equipment must be equipped with an operable horn that must be used as needed when the machinery is moving in either direction.
  - ✓ All bi-directional equipment must also have an operable alarm in addition to the horn.
  - ✓ All equipment must be provided with a multi-purpose (class A, B, and C) fire extinguisher mounted in an easily accessible location.
  - ✓ Braking systems, controls, safety devices must be maintained in effective operating condition.
  - ✓ The operator must inspect the equipment at the beginning of the shift and test for acceptable

- ✓ operation as per the equipment's manufacturer's instructions. Inspections must be documented and filed.
- ✓ Only qualified personnel must be allowed to operate equipment. Qualification must be documented and filed.

In case any worker violates any of the EHS rules identified by BHEL as above, following punitive action shall be taken:

| First Offence | Second Offence | Third Offence | Fourth Offence |
|---|---|---|---|
| *Oral warning* | *Gate Pass Punched* | *Gate pass punched (second)* | *Gate Pass Punched(third) and person sent out of the gate*<br><br>*Photo of concerned worker to be displayed on Notice boards and prominent locations.* |

BHEL has the right to send out such person even earlier than fourth offence after considering the severity of the offence and/or the persons track record related to following general/EHS rules.

BHEL reserves right to expel even concerned supervisor or engineer as well in case of repeat of such cases of indiscipline.

**Note:**
The appellate authority in this case shall be the BHEL Site In-charge whose decision shall be final on the matter and binding on all parties.

## *8. PLANNING FOR HSE*

### A. Identifying Hazards / Risks & Aspects / Impacts and implementing control measures

1. Subcontractor shall identify all OHS Hazards and Risks applicable to all activities in scope as per *HSEP01: HSE Procedure for OHS Hazards and Risks*, and plan & implement the required control measures.

2. Subcontractor shall identify all Environmental Aspects and Impacts applicable to all activities in scope as per *HSEP02: HSE Procedure for Environmental Aspects and Impacts*, and plan & implement the control measures.

### B. Register of Regulations:

Subcontractor shall prepare a register of applicable rules and regulations in the scope as per

*HSEP03: HSE Procedure for Register of Regulations* and plan to ensure compliance.

The detailed plans and registers in A and B to be submitted to BHEL for review and approval within 60 days of start of work at site.

**Note:** The plans above are dynamic and shall be periodically reviewed as per BHEL requirement.

## 8.1 MOBILISATION OF MACHINERY / EQUIPMENT / TOOLS

1. Subcontractor shall furnish to BHEL, the Test Certificates issued by the jurisdictional competent persons of machinery, equipment and other T&Ps to be deployed at site, before deployment. BHEL reserves the right to disallow the same if found non-conforming to HSE / legal requirements

2. As a further measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and comply with legislative and owner requirement, inspection shall be arranged by in-house expert / competent authority (preferable) for acceptance. (**Report Format: HSEP:14-F15)**

3. **The equipment considered for this purpose shall include all those in the T&P list in the tender document. Conventional Hydra crane with carriage in front shall not be permitted. Other models like FX or TRX series of Escorts or equivalent shall be permitted.**

4. In the course of work, the subcontractor shall notify the BHEL Engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard.

5. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions.

6. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.

7. Following items should be only ISO certified and not more than 2 yr. of purchase
    i. Chain pulley block
    ii. Wire rope slings
    iii. Grinding machine and wheel and buffing wheel
    iv. Gas cutting equipment
8. Following equipment should not be more than 5 Yr. old
    1. Welding machine
    2. Vibrator Machine
    3. Concrete cutter
    4. DB/Electrical panel
9. **Office Infrastructure** - subcontractor shall arrange a computer / Laptop with Network

connection, chair and table for HSE Staff to facilitate HSE reporting and recordkeeping.

## 8.2 MOBILISATION OF MANPOWER

1. As a measure to ensure that manpower being mobilized to the construction site is fit and competent for safe working, screening arrangement shall be made by the sub-contractor to ensure fulfillment of contractual as well as legislative requirement by:

i. Ensuring the required qualification/ training/ certification/ license and experience for the job as per Section 7 of this document & applicable legal requirements

ii. **Medical Checkup:** Examination of medical fitness shall be conducted through qualified medical professional for all workers to be deployed. (Record: Format No. HSEP14:F02)**.** For height workers, height phobia test to be carried out as qualification criteria.

iii. **Induction Training:** Induction training of all workers to be ensured as per clause 9.1 and HSEP04: *HSE Procedure for Training & Awareness (Record:* Format No. HSEP14:F03)

Only on successfully meeting above criteria, permanent gate passes to be issued.

2. The subcontractor shall strictly adhere to the maximum daily working hours and other requirements as per applicable laws and shall not engage any employee below 18 years of age.
3. The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.
4. Ensure that the regulatory requirements of excessive weight limit (to carry / lift / move weights beyond prescribed limits) for male and female workers are complied with.
5. System for Issue of Gate Passes to authorized personnel only shall be ensured at site
6. The subcontractor shall keep accurate and updated records of all manpower preferably in soft form
7. The subcontractor shall ensure appropriate infrastructure for workers as per Clause 8.4.

## 8.3 PROVISION OF PPEs

1. Adequate numbers of Personnel Protective Equipment (PPEs), will be made available at site & their effectiveness and regular use by all will be ensured

2. The PPEs shall conform to the relevant standards as listed in Annexure 02, and bear ISI mark.

3. The following matrix recommends usage of minimum PPEs against the respective job. For details, the respective OCPs to be referred.

| Sl. No | Type of work | Suggested PPEs |
|---|---|---|
| 1 | Work at height | Double lanyard full body harness with rope grab (as applicable), retractable Fall arrestor (specific cases), Safety nets (single / double) |
| 2 | Concrete and asphalt mixing | Nose mask, hand glove, apron, gum boot, goggles |
| 3 | Welders/ Grinders/ Gas cutters | Welding/face screen, apron, hand gloves, nose mask and ear muffs if noise level exceeds 90dB. Helmet fitted with welding shield is preferred for welders, safety goggles |
| 4 | Stone/ concrete breakers | Ear muffs, safety goggles, hand gloves |
| 5 | Electrical Work | Rubber hand glove, Electrical Resistance shoes, Arc-flash resistant suit. |
| 6 | Insulation Work | Respiratory mask, Hand gloves, safety goggles |
| 7 | Grit/Sand blasting | Blast suit, blast helmet, respirator, leather gloves, safety goggles |
| 8 | Painting | Plastic gloves, Respirators (particularly for Spray painting) |
| 9 | Radiography | As per BARC guidelines |
| 10 | General | Helmets, Safety Shoes Reflective vests, ear plugs, nose masks, safety goggles |

4. The exact PPEs required for a particular task shall be chosen to ensure there are multiple lines of defense against accident or injury. All applicable safety precautions for a job shall be ensured notwithstanding the duration or perceived importance of the task.
5. Additionally, the BHEL safety officer may demand additional PPEs based on specific requirement
6. The applicability of PPEs shall be as per the concept of Hierarchy of controls, i.e.: Elimination->Substitution->EngineeringControls->AdministrativeControls-PPEs
7. Relying solely on PPEs without other applicable controls to be strictly avoided.
8. The issuing agency shall maintain register for issue and receipt of PPEs (Format No. HSEP: 14-F06A). All the PPEs shall be checked for quality before issue and the shall be periodically re-checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be replaced.
9. The body harnesses shall be serial numbered.
10. All worker should wear reflecting Jacket during both shift Day/Night.
11. Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public
12. Besides the PPEs mentioned above, the persons shall use helmet, safety shoe and reflective vest at all times. The visitors shall use Helmet and any other PPEs as

deemed appropriate for the area of work.

13. Following color scheme for Helmets to be maintained:
    a. Workmen: Yellow
    b. Safety staff: Green or white with green band
    c. Electrician: Red
    d. Others including visitors: White
14. The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front along with the person's gate pass no. & blood group. An awarded worker shall have reflective logo

## 8.4 ARRANGEMENT OF INFRASTRUCTURE

The subcontractor is responsible for ensuring and maintaining the required HSE infrastructure at site as described in this Section

### 8.4.1 DRINKING WATER

1. Drinking Water Storage Tanks shall be provided and maintained at suitable places at different elevations / locations to ensure easy accessibility. The tank/container shall be kept on a platform at an elevation of at least 2 feet and should be covered:

2. **Construction and Quantity:** The design of Drinking Water Storage Tank (DWST) shall be submitted to BHEL for approval prior to initiating construction. Provision of 5 liter water daily for each worker to be maintained.
3. **Labelling:** DWST should be labeled as "Drinking Water". Date of last cleaning, next due date shall be indicated on the container besides Date of source testing as per IS 10500.
4. Cleaning of the DWST shall be ensured at least once in a week. Mild cleaning detergents as used for cleaning vessels shall be applied and scrubbers (3M or equivalent) shall be used for removing scales and deposits on the inside surface. The tank shall be thoroughly cleaned with potable water only before it is refilled.
5. Suitability of the water source should be tested as per IS10500.
6. For all tanks containing water unsuitable for drinking, prominent "Do Not Drink" signage shall be pasted in English, Hindi and local language.
7. In Hot Work and other critical areas, drinking water shall be made available near the activity
8. Provision of supplying drinking water to height workers and those working in difficult to reach

areas shall be made available through dedicated personnel.

8.4.2 **PROVISION OF LATRINES AND URINALS AT SITE** (Ref: Interstate Migrant Workmen (Regulation & Employment and Act, 1979) read with The Inter-State Migrant Workmen (Regulation of employment and conditions of service) central rules, 1980 (PI refer rule no. 42)

**LATRINES**

1. Latrines shall be provided in every establishment on the following scale, namely: -

   a. Where females are employed, there shall be at least one latrine for every 25 females;
   b. Where males are employed, there shall be at least one latrine for every 25 males:

   Provided that where the number of males or females exceeds 190, it shall be sufficient if there is one latrine for 25 males or females, as the case may be, up to the first 100, and one for every 30 thereafter

2. Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.
3. Where workers of both sexes are employed there shall be displayed outside each block of latrine and urinal a notice in the language understood by the majority of the workers **'For Men Only'**, or **For Women Ónly'**, as the case may be.
4. The notice shall also bear the figure of a man or of a woman, as the case may be.

**URINALS**

5. There shall be at least one urinal for male workers up to fifty and one for female up to fifty employed at a time:
6. Provided that where the number of male or female workmen, as the case may be, exceeds 500 it shall be sufficient if there is one urinal for every fifty females up to the first 500 and one for every 100 or part thereof thereafter.
7. The urinals shall be designed and located so as to ensure privacy.
8. In case a structure encompasses multiple floors, urinals shall be provided suitably for quick access
9. The latrines and urinals shall be conveniently situated and accessible to workers at all times at the establishment.
10. The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
11. Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the public health authorities.
12. Water shall be provided by the means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.

### 8.4.3 WASHING FACILITIES

1. In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
2. Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic

condition and dully illuminated for night use.

3. Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

### 8.4.4 PROVISION OF REST SHELTER FOR WOKERS

Proper Sheds & Shelters big enough to accommodate all possible workers shall be provided for workers to rest during break. Taking rest at height, in activity area and other hazardous locations shall not be allowed.

The drawing of such sheds shall be submitted to BHEL for approval before construction.

### 8.4.5 MEDICAL FACILITIES

**Refer Section B for applicability of requirements pertaining to Clause 8.4.5.1**

8.4.5.1 MEDICAL CUM FIRST-AID CENTER

a) A medical center shall be setup at site with basic facilities for handling medical emergencies. The medical center shall be developed independently by BHEL/an agency as specified in the contract and run jointly by all agencies on proportionate sharing basis as stipulated in the contract.
b) A qualified medical professional, not less than MBBS, shall be deployed at medical center as stipulated in the contract.(Part-time or full time as decided at the site).
c) There shall be a full-time trained first aider and a nurse. Depending upon the working hours at the site, First-aider shall be deployed accordingly.
d) The center shall have all articles as per Schedule IV of BOCW(Central) Rules'1998. In addition,, one Stokes basket stretcher shall be available.
e) An ambulance shall be deployed for every 1000 persons along with trained driver and accessories as per schedule V of Central BOCW Rules'1998. Depending upon the working hours at the site, First-aider shall be deployed accordingly.
f) The center shall be adequately equipped for Resuscitation, Immobilisation, Dressing, dealing with poisoning cases including snake and insect-bites and sufficient stock of emergency medicines as prescribed by the qualified medical professional as per point (b)

### 8.4.5.2 IMPORTANT

g) If there is no specific mention of responsibility of deployment or setting up of any of the above facilities and operating expenses thereof, BHEL site management shall have the liberty to give this responsibility to any of the contractors on cost sharing basis.
h) Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules, 1998)
i) Every injury shall be treated, recorded and reported.
j) All First Aid injuries shall be recorded as per Format No. HSEP:14-F17
k) List of qualified first aiders and their contact numbers to be displayed at conspicuous places.

### 8.4.5.3 FIRST AID

**A. In addition to 8.4.5.1 &2, The subcontractor with Boiler&ESP, TG, Civil shall:**

1. Provide necessary first aid facilities for every work place.
2. Ensure availability of qualified First-aider throughout the working hours.
3. Every injury shall be treated, recorded and reported.
4. Refresher course on first aid shall be conducted as necessary.
5. List of qualified first aiders and their contact numbers to be displayed at conspicuous places.
6. All First Aid injuries shall be recorded as per Format No. HSEP:14-F17

**B. FIRST AID BOX**

1. The first aid box shall be maintained by first aider who shall always be readily available during the working hours of the work place.
2. **Details of First Aid Box:**
   a) Details of contents of first aid box is given in **Annexure 03.** A slip of contents shall be pasted on the First Aid Box with following details:

      **Name, Quantity, Expiry Date, Checked by…**
   b) First Aider's name and contact no to be displayed on the box.
   c) The first aid box shall be distinctly marked with a Green Cross on white background.
   d) The box shall be properly secured with lock & key to avoid misuse
7. The first aid boxes should be placed at various locations so as to make them available within easy reach of hazardous activities and at the quickest possible time.
8. The subcontractor shall ensure that the Supervisors and Engineers are adequately trained for attending to any emergency.
9. Monthly inspection of First Aid Box to be conducted by the subcontractor as per Format no. HSEP:14-F01

### 8.4.5.4 HEALTH CHECK UP

The persons engaged at the site shall undergo health checkup as per the **Format no. HSEP:14-F02** before induction. The persons engaged in the following works shall additionally undergo regular health checkup using same Format at least once in a year:

| | | |
|---|---|---|
| Height workers | Drivers/crane operators/riggers | Confined space workers |
| Shot/sand blaster | Welding and NDE personnel | Any person referred by BHEL |

### 8.4.5.4.1 HEIGHT PHOBIA TEST

1. The persons engaged in working at heights (above 2 meters) to be assessed for Height Phobia and associated conditions.
2. Such workers are to be allowed only on successful completion of this test, otherwise they shall be allocated ground based jobs. IDs / Height passes shall be issued to such workers.

### 8.4.6 PROVISION OF CANTEEN FACILITY

**Minimum or better facilities to be ensured as per BOCW (Rule 244) / Factories Act, specially taking care of the following:**

1. Canteen facilities shall be provided for the workmen of the subcontractor inside the project site.
2. Proper cleaning and hygienic condition shall be maintained.
3. Proper care should be taken to prevent biological contamination.
4. Adequate drinking water should be available at canteen.
5. Fire extinguisher shall be provided inside canteen.
6. Regular health check-up and medication to the canteen workers shall be ensured.
7. Canteen waste to be disposed of in compliance with law
8. Domestic LPG cylinder shall not be used
9. Canteen should be periodically inspected using standard checklist finalized along with BHEL

### 8.4.7 PROVISION OF ACCOMMODATION / LABOR COLONY

1. The subcontractor shall provide to every workman (within fifteen days of the commencement of the employment of migrant workmen):

a) In case he is accompanied by any other member of his family, a suitable barrack so as to accommodate one room having at least a floor area of 10 square meters, a verandah and adequate additional covered space for cooking food as well as one common sanitary latrine, one common bathroom for every three such quarters; and

b) In case he is unaccompanied by any other member of his family, a suitable barrack so as to accommodate not more than ten such migrant workmen, having at least a floor area of not less than 6.5 square meters for each such migrant workman making use of the barrack, a verandah and adequate additional covered space for cooking food as well as one common sanitary latrine and one common bathroom for every ten such migrant workmen

2. Every quarter and the barrack shall be so constructed as to afford adequate ventilation, protection against heat, wind, rain and shall have smooth, hard and impervious floor surface.
3. The quarters or the barracks, as the case may be, shall be at a convenient distance from the establishment and shall have adequate supply of wholesome drinking water.
4. The area in which the quarters and/or barracks are located as well as the latrines and bathrooms provided therein shall be kept in a clean and sanitary condition at all times.
5. Regular housekeeping of the labor colony shall be ensured.
6. Availability of Bathing/ washing bay to be ensured

7. Room ventilation and safe electrification to be ensured
8. MSDS of LPG shall be put up prominently and shall be included in the induction training also.
9. The labor colony shall be secure so that only authorized persons have access to it.
10. Availability of local market to be ensured by the Sub-contractor
11. A "Suggestion Register" shall be made available at the labor colony for workers. The feedback shall be reviewed on weekly basis and acted upon.
12. Labor colony shall be inspected fortnightly by Subcontractor Safety Officer & HR executive, and report submitted to BHEL as per Format No. HSEP:4-F16
13. **Facility of Crèches –** to be provided wherein more than fifty female workers are deployed
14. Provisions of Clause 8.4.1, 8.4.2 and 8.4.3 shall be applicable on labor colony as well

### 8.4.8 PROVISION OF EMERGENCY VEHICLE

Dedicated emergency vehicle shall be made available at workplace by subcontractor for evacuation of victim from site.
However, Ambulance shall be used exclusively for transporting victim to hospital

### 8.4.9 PEST CONTROL

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labor colony and stores by the subcontractor.

### 8.4.10 SCRAPYARD

1. Scrapyard shall be developed by subcontractor to store metal scrap, wooden scrap, waste, hazardous waste.
2. Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

### 8.4.11 ILLUMINATION

1. The subcontractor shall provide adequate lighting facilities e.g. flood lighting, hand lamps, area lights etc. to ensure adequate lighting at all work places & their approaches including passage ways as per IS: 3646 (Part-II) at all times. Indicative recommended values are given below:

| S. No. | Location | Lux Level |
|---|---|---|
| A. | **Construction Site** | |
| 1 | Outdoor areas like store yards, entrance and exit roads | **20** |
| 2 | Platforms | **50** |
| 3 | Entrances, corridors and stairs | **100** |
| 4 | General illumination of work area | **150** |
| 5 | Rough work like fabrication, assembly of major items | **150** |

| | | |
|---|---|---|
| 6 | Medium work like assembly of small machined parts | **300** |
| 7 | Fine work like precision assembly, precision measurements etc. | **700** |
| 8 | Sheet metal works | **200** |
| 9 | Electrical and instrument labs | **450** |
| B. | **Office** | |
| 1 | Outdoor area like entrance and exit roads | **20** |
| 2 | Entrance halls | **150** |
| 3 | Corridors and lift cars | **70** |
| 4 | Lift landing | **150** |
| 5 | Stairs | **100** |
| 6 | Office rooms, conference rooms, library reading tables | **300** |
| 7 | Drawing table | **450** |
| 8 | Manual telephone exchange | **200** |

In case any area is not mentioned above, the applicable illumination for the same shall be specified by BHEL based on applicable standards and international norms

1. Level of illumination shall be checked periodically using a calibrated lux meter and recorded for each work area on minimum weekly basis as per Format No. HSEP:14-F21
2. Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
3. Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
4. Emergency lighting provision for night work shall be made to minimize danger in case of main supply failure.

## *9. HSE TRAINING & AWARENESS*

### 9.1 HSE INDUCTION TRAINING

1. All persons entering into project site shall be given HSE induction training before being assigned to work, which shall be imparted through audio-visual medium and shall be of minimum 2-hour duration.

2. Any single trainee batch size should not exceed 40.

3. Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)

i. They must arrive fully dressed in safety wear & gear to attend the induction.
ii. Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.

4. In-house induction training subjects shall include but not limited to:

i. Briefing of the Project details and importance of employee for the project and for the nation.
ii. Safety related cardinal rules, objectives and targets.
iii. Site HSE rules.
iv. Site HSE hazards and aspects.
v. First aid facility.
vi. Emergency Contact No. and procedures
vii. Details of Fire prevention and emergency response systems & procedures at site.
viii. Requirement of incident / near miss reporting by all.
ix. Accident case studies
x. Rules to be followed in the labor colony (if applicable)

5. Evaluation to be carried out after training and induction training to be repeated in case of failure of participant in evaluation

6. On completing subcontractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP: 14-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the work site (provided Health Checkup is over).

## 9.2 HSE TOOLBOX TALK

1. HSE Tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups daily prior to the start of work. The agenda shall consist of the following:

   i. Visual checkup of workers regarding health, any signs of fatigue, intoxication etc.
   ii. Details of the job being intended for immediate execution.
   iii. The relevant hazards and risks involved in executing the job and their control measures.
   iv. Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
   v. Recent non-compliances observed.
   vi. Appreciation of good work and warning for any unsafe acts done by any person.
   vii. Any doubt clearing session at the end

**2.** Record of Tool box talk shall be maintained as per Format no. HSEP:14-F04

## 9.3 TRAINING ON HEIGHT WORK

Due to the large percentage of fall from height in incidents, training of minimum 2-hour duration on height work shall be imparted to all height workers by in- house / external faculty for every batch of new inductees. The training shall include following topics:

1. Inspection of work area, access and egress w.r.t height hazards
2. Use of PPEs; use of fall arrester, retractable fall arrester, life line, safety nets etc.
3. Safe climbing through monkey ladders.
4. Inspection of PPEs.
5. Medical fitness requirements.
6. Mock drill on rescue at height.
7. Dos & Don'ts during height work.

8. Accident case studies

In case, above is organized by BHEL, proportionate cost shall be borne by subcontractors

### 9.4 HSE TRAINING DURING PROJECT EXECUTION

1. HSE training shall be arranged by subcontractor as per the need of the project execution and recommendation of BHEL.
2. The topics of the HSE training shall be as follows but not limited to:

i. Hazards identification and risk analysis & Identification of Environmental Aspects / Impacts
ii. Work Permit System
iii. Learning from past incidents
iv. First aid, Firefighting & Fire-warden training
v. EMS and OHSMS
vi. T & Ps fitness and operation
vii. Electrical & Chemical safety
viii. Welding, NDE & Radiological safety
ix. Material handling.

3. Safety awareness and on-the-job training programmes shall be carried out at site for all workers periodically. Periodicity to be decided by BHEL but shall be minimum once in six months
4. Penalty Training – In case of any incident, the involved person, group or agency shall undergo a penalty HSE training for a minimum period of 2 hrs or as decided by BHEL.
5. In case it is not possible to provide training to all workers at once, same shall be imparted in Batch-wise manner so as to cover all workers with specified periodicity.
6. An up-to-date record to be maintained with attendance of participants and trainers preferably in soft copy as per Format No. HSEP:14-F03.
7. Every employee of agency should be provided at least 2 hr. safety training in every month.

In case, above is organized by BHEL, proportionate cost shall be borne by subcontractors

## *10. HSE PROMOTION: SIGNAGE, POSTERS, COMPETITION, AWARDS ETC*

### 10.1 DISPLAY OF HSE POSTERS AND BANNERS

Site shall arrange appropriate posters, banners, slogans in local/Hindi/English languages at work place.

### 10.2 DISPLAY OF HSE SIGNAGE

Appropriate HSE signage shall be displayed at the work area to enhance awareness of HSE workmen and passersby about the work going on and do's and don'ts to be followed.

### 10.3 COMPETITIONS ON HSE, AWARDS & REWARDS

1. Subcontractor shall arrange competitions (slogan, poster, essay etc.) on HSE for workers and employees from time to time (Safety day, World Environment Day etc. minimum one such function each month) and winners will be suitably awarded during the functions.

2. Subcontractor shall identify workers following good HSE practices and reward them from time to time as encouragement to follow good HSE practices.

3. Alternatively, if a common monthly function is organized at site, subcontractor shall participate in the same so that a minimum frequency of one such function per month is maintained.

### 10.4 HSE AWARENESS PROGRAMMES

Subcontractor shall arrange HSE awareness programmes periodically on different topics including medical awareness for all personnel working at site from time to time including officials involved in execution.

## *11. HSE COMMUNICATION AND PARTICIPATION*

### 11.1 MONTHLY HSE REPORTING

1. HSE activities shall be reported to BHEL monthly as per Format no. HSEP: 14-F05. The reporting medium can be hard/soft as per BHEL requirement.

2. The period of reporting shall be 25$^{th}$ of the preceding month to 24$^{th}$ of the present month and report shall be submitted by the end of the calendar month or as conveyed by BHEL.

3. BHEL can modify the reporting requirements as per requirement

### 11.2 HSE EVENT REPORTING

1. Important HSE events like HSE Training, Mock / Fire/Rescue Drills, Medical camp etc. organized by subcontractor shall be reported to BHEL in detail with photographs

2. Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported likewise.

### 11.3 HSE INCIDENT REPORTING

All incidents (near misses, property damage, first-aid cases, minor, major and fatal incidents) shall be reported to BHEL as they happen through SMS and Hard/Soft copy as per Format No. HSEP: 14-F22

### 11.4 HSE SUGGESTIONS

All workers and employees to be encouraged to provide suggestions for improvement in

Health, Safety & Environment at site. The suggestions to be recorded in a "Suggestions Register". Suggestions to be reviewed and those having potential of significant beneficial effects are to be implemented, and recognition / award to be given to the individual.

### 11.5 CLIENT COMMUNICATON

All HSE related communication from BHEL, customer / external statutory and regulatory agencies to be handled on priority. The relevant issues to be resolved in expeditious manner

### 11.6 RECORDS OF COMMUNICATON

Records of all communication and their responses as detailed above shall be maintained by subcontractor in hard / soft copy and produced when required.

## *12. INCIDENT REPORTING, INVESTIGATION & CORRECTIVE ACTION*

1. A conducive environment for reporting of near misses and other incidents shall be developed at site through system of rewards etc.
2. Priority to be given to ensure medical treatment of the victim. Victim to be given immediate First Aid and transported to Medical Facility in a well-equipped Ambulance
3. All incidents, as they happen, shall be reported to BHEL immediately over phone/SMS/Whatsapp/mail and then in Format No. HSEP:14-F22 within 24 hrs. of occurrence. Immediate SMS shall be sent to concerned Package In-charge with following Details:
    a. Project & Customer Name:
    b. Subcontractor Name & Scope:
    c. Incident Area:
    d. Number of Injured / Fatalities:
    e. Date & Time of Accident:
    f. Incident Description in few lines:

    No incident shall be hidden
4. Records of all incidents shall be maintained in hard / soft copy as per Format No. HSEP:14-F23.
5. For all incidents:
    a. The incident area, equipment / tools involved, documents & records etc. shall be maintained as-it-is pending investigation
    b. Root Cause Analysis (RCA) to be conducted and corresponding Corrective / Preventive Action (CAPA) ensured
    c. Responsibility shall be assigned and action to be taken against the erring individual
    d. In case presence of manufacturer of the equipment involved is required, subcontractor will arrange the same

e. All expenses pertaining to the RCA / CAPA shall be borne by the subcontractor

6. RCA and CAPA reports of all near misses and minor injuries shall be identified and report submitted to BHEL within 7 days of occurrence.
7. For incidents, where worker does not resume duty within 48 hours of occurrence, Joint investigation along with BHEL shall be conducted within 7 days, and CAPA ensured.
8. Corrective action shall be immediately implemented at the work place. Work shall be put on hold in the area till corrective actions are verified by BHEL
9. All incidents, their Root Cause Analyses and Corrective actions shall be recorded, and analyzed so as to identify weak areas and actions to be taken to reduce the incident trend.

## *13. SAFETY DURING WORK EXECUTION*

### 13.1 HSE SYSTEMS AND PROCEDURES

BHEL Power Sector HSE Management System (HSEMS) shall be referred for controlling hazards, aspects, and carrying out HSE activities at site. Subcontractor shall get familiar with and follow the HSEMS documents provided by BHEL which include the follows:

#### 13.1.1 HSE PROCEDURES:

All HSE Procedures defined in HSEMS, as referred in various sub-clauses of this Section as given in Annexure 01

#### 13.1.2 PERMIT TO WORK (PTW) SYSTEM

1. The following activities shall be carried out by the subcontractor strictly after obtaining Permit to Work (PTW) from BHEL

   i. General Work Permit (**Format No. HSEP14-FP01)**
   ii. Height working (**Format No. HSEP14-FP02)**
   iii. Hot working (**Format No. HSEP14-FP03)**
   iv. Confined space Work (**Format No. HSEP14-FP04)**
   v. Excavation more than 2-meter depth (**Format No. HSEP14-FP05)**
   vi. Radiography / Radiation Work (**Format No. HSEP14-FP06)**
   vii. Heavy / Complex / Critical Lifting Activity (**Format No. HSEP14-FP07)**
   viii. Night / Holiday Work (**Format No. HSEP14-FP08)**
   ix. Material Loading / Unloading Permit (**Format No. HSEP14-FP09)**
   x. Grating / Safety Net / Safety Facility Removal Permit (**Format No. HSEP14-FP10)**
   xi. Live Electrical Maintenance etc. - Lockout / Tag (**Format No. HSEP14-FP07)**

2. The above list is not exhaustive. BHEL reserves right to introduce additional Permits or modify requirements for usage of existing Permits. The conditions for using the Permit are specified in the Format (General Requirements).

3. Where customer is having separate Work Permit System the same shall be followed in conjunction to ensure all activities and checks are covered in all systems.

4. Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work along with Job Hazard Analysis.

5. All Permit signatories shall physically visit the work area and check that all the safety control measures necessary for the activity are in place. Only then the permit shall be issued.
   a. Signatory shall physically visit the area of work and ensure all required safeguards before signing the Permit
   b. Signatory shall periodically visit the area to confirm the availability of required safeguards throughout the currency of the permit
   c. In case any Permit requirement is not available, work will be stopped till it is made available

6. Permit holder shall implement and maintain all control measures during the period of permit. The permit will be closed after completion of the work and submitted to BHEL.

### 13.1.3 Operational Control Procedures

1. All applicable OCPs (Operational Control Procedures) as identified from outcomes of HIRA, Aspect / Impact studies and BHEL inputs will be followed by subcontractor. This will be done as part of normal scope of work.
2. Illustrative list of such OCPs is given in Table 13.1 and same will be made available to subcontractor by BHEL during work execution at site.
3. In case any other OCPs are required or existing ones need to be modified in order to control the risks / impacts associated with any activity during the execution of work subcontractor shall prepare / update and follow the same with information to BHEL.

***Table 13.1 - LIST of Reference OCPs***

| No. | Topic | No. | Topic | No. | Topic |
|---|---|---|---|---|---|
| 0 | General Safety | 20 | Oil flushing | 40 | Gas distribution test |
| 1 | Handling of chemicals | 21 | Alkali boil out | 41 | Cleaning of Hotwell / Deaerator |
| 2 | Electrical safety | 22 | Steam blowing | 42 | Electrical maintenance |
| 3 | Energy conservation | 23 | Working in confined area | 43 | O&M of control of AC plant & system |
| 4 | Welding and gas cutting operation | 24 | Operation of passenger lift, material hoists & cages | 44 | Material preservation |
| 5 | Fire safety | 25 | Vehicle/ Crane maintenance | 45 | Electro-resistance heating |
| 6 | Use of hand tools | 26 | Radiography | 46 | Blasting |
| 7 | First aid | 27 | Waste disposal | 47 | Transformer charging |

| | | | | | |
|---|---|---|---|---|---|
| 8 | Food safety at canteen | 28 | Handling & storage of mineral wool | 48 | Handling of battery system |
| 9 | Use of cranes | 29 | Working at night | 49 | DG set |
| 10 | Storage and handling of gas cylinders | 30 | Computer operation | 50 | Sanitary maintenance |
| 11 | Manual arc welding | 31 | Storage in open yard | 51 | Piling rig operation |
| 12 | Use of helmets | 32 | Drilling, reaming and grinding(machining) | 52 | Passivation |
| 13 | Good house keeping | 33 | Stress relieving | 53 | EDTA Cleaning |
| 14 | Safe excavation | 34 | Hydraulic test | 54 | Chemical cleaning of Pre boiler system |
| 15 | Working at height | 35 | Trial run of rotary equipment | 55 | Boiler Light up |
| 16 | Filling of hydrogen in cylinder | 36 | Batching | 56 | Rolling and Synchronization |
| 17 | Illumination | 37 | Cable laying/tray work | 57 | Loading of Unit |
| 18 | Handling and erection of heavy metals | 38 | Spray insulation | 58 | Air compressor |
| 19 | Acid cleaning | 39 | Compressor operation | 59 | Hydra Operation |

## 13.2 ACTIVITY SPECIFIC REQUIREMENTS FOR SAFETY:

All Work shall be commenced only after taking the respective Work Permits (as applicable) and precautions as per relevant codes, systems and OCPs in order to ensure safe conditions throughout the duration of work. Additionally, activity specific safeguards as per this section shall be followed.

### 13.2.1 WORK AT HEIGHT:

1. All work at height above 2 meter above ground level without complete platforms, handrails and other related fall protection shall require a work permit in the prescribed form. This shall require approval by the competent authority. The HSE officer of sub-contractors shall follow the checklist religiously by physically verifying the condition of the work area before recommending for approval.

2. Prior to the start of work at elevation, the HSE Officer involved with the work must meet the work supervisor to review the scope of work, and must review all the possible fall hazards and effective safety responses. The evaluation / analysis must be documented and kept on file and on site by the HSE Officer.

3. Whenever a fall hazard or other exposure exists for working at heights more than 2.0m/6ft, the nature and scope of work will be evaluated for conditions and environmental factors before selecting the appropriate fall protection system (active, passive or a combination of measures, as appropriate).

4. All Engineering and Administrative Controls including barricading, safe platform, Safety Nets etc. shall be made available at work location. Under no circumstances, there shall be total reliance on PPEs only

5. **Safety Nets**

   a. Contractor shall maintain sufficient stock of Safety Nets for deployment
   b. Safety Nets as per IS: 11057:1984 should be used extensively for prevention / arrest men and materials falling from height.
   c. The safety nets shall be fire resistant, duly tested and shall be of ISI marked.
   d. Safety Nets shall be deployed below all platforms where height work is envisaged. Duration of work, delay shall be no excuses for non-installation of Safety Net

6. Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
7. Monkey Ladder shall be fitted with cages. Rope ladder should be discouraged.
8. In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
9. In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
10. For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor.
11. The procedures for the safety response to identified fall hazards developed and rescue plans must be reviewed with all individuals exposed to the hazards.
12. The HSE Officer must establish an inspection process of fall protection systems. Some equipment requires documented inspections by its manufacture on a regular schedule. Such equipment must have evidence of the inspection and re-certification process on it. This information must be reviewed before the equipment is actually used. Individuals must visually inspect the fall protection equipment before each use. Failure to complete this inspection process could result in serious injury or death.
13. Immediately remove from service any fall protection equipment that is identified as defective, damaged, or has been subjected to an impact. Damaged fall protective equipment must be destroyed to prevent re-use and not be discarded into trash containers, as the worn or damaged equipment could be unintentionally re-used.
14. Aerial lifting devices, excluding scissor lifts require the use of full body harnesses and lanyards in any elevated position.

**13.2.1.1 Personnel fall protection system must include:**

**a. Safety Harness**

All height workers must use Safety harness with double lanyards. The primary lanyard is never unhooked until the secondary lanyard is secure. The design of the working platform should be such that u**nder no circumstances, worker should have both lanyards unhooked while at height.**

**b. Lanyard**

i. The type of work and the environment conditions determine lanyard and lifeline selection. If welding, chemical cleaning that may damage lanyards, connectors or lifelines, sandblasting, etc., either protect the components or use more appropriate type of system.

ii. Lanyards and lifelines must incorporate, or be used with, an appropriate deceleration (shock absorbing) device. Deceleration devices include rope grabs, rip-stitch lanyards, specially woven lanyards, tearing, or deforming lanyards, automatic self-retracting lifelines and lanyards which dissipate or limit the energy imposed on the employee during fall arrest.

iii. Once in use, the system's effectiveness is to be monitored. In some cases, a program for cleaning and maintaining the system may be necessary. Lanyard and lifelines must use locking snap hooks only and under no circumstances must two lanyard snap hooks be connected.

**c. Lifeline**

All lifelines in general are to be made of min 8mm dia steel rope (plastic coated) and tied to columns with 3 clamps at each end. Wherever columns are not available to tie the lifelines, the vertical posts as per the design below are to be provided after carrying out drop load test initially. A load of 240kg to be dropped off the mid-point of lifeline in this test.

**d. Lifeline Post**

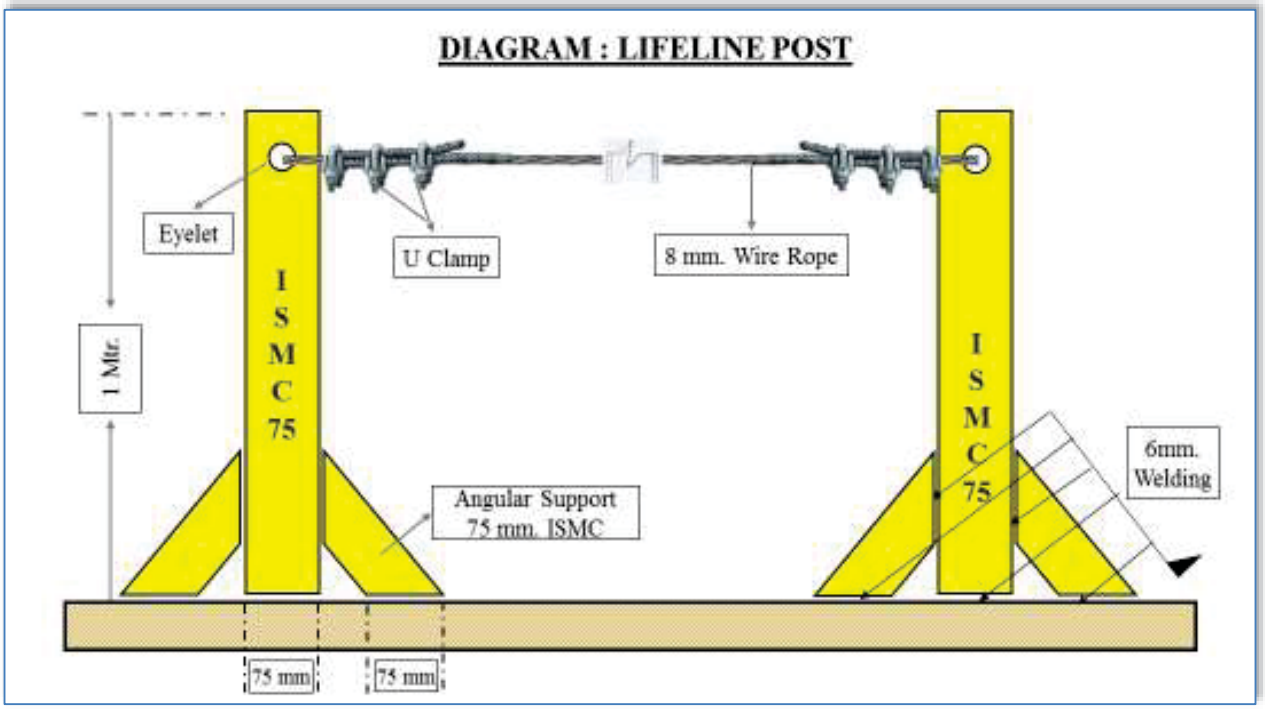



**Fig. 13.2.1.1 Lifeline Post**

i. The support at vertical post shall be fixed at end-to-end. The maximum length of one end to another end shall be 18 meters
ii. If the length of a lifeline is more than 18 meters, then intermediate vertical post(s) are to be used. Such intermediate post(s) will act as supports and the lifeline rope should simply pass through the eyelets (holes) of such supports without being anchored
iii. The lifeline need not be wrapped / clamped to any intermediate post
iv. Such intermediate posts must be used at an interval of every 18 meters
v. The post(s) in which the original lifeline is to be installed should be capable of sustaining a tensile stress of 2268 Kgs
vi. In a horizontal lifeline installation, maximum allowable sagging is 500-600 mm
vii. For a single spun lifeline, no more than 2 persons are allowed to work; for more than two workers, another lifeline should be installed
viii. Horizontal lifeline should be so installed that it does not impede safe movement of workers
ix. All the installation work must be carried out by competent person with adequate knowledge

### 13.2.1.2 Working Platform

1. Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width, which shall not be less than 750 mm and be suitably fenced.

**2. Precautions against the fall of Materials, Persons and Collapse of Structures**

i. Every opening in the floor or a building or in a working platform shall be suitably barricaded to prevent the fall of persons by providing suitable fencing or railing whose minimum height shall be 90 cm.

ii. Adequate precautions should be taken such as the provision of fencing, or barriers to protect any person who might be injured by the fall of materials, or tools or equipment being raised or lowered. Cradle may be used for lifting materials - however this shall be made of MS angles and flats only and duly certified by the HSE officer. Operators may also use designed containers for lifting small tools.

iii. Guardrails (including scaffolding) erected over/adjacent working areas must have the guardrails screened (opening < 0.5), to prevent material from falling outside the platform/decking.

iv. Guardrails must be able to withstand a 200-pound force exerted in any one direction.

v. Where necessary to prevent danger, guys, stays or supports should be used or other effective precautions should be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.

vi. All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.

vii. Guardrails and toe-board/barricades and sound platform conforming to IS: 4912-1978 and other Indian laws and regulations as depicted below should be provided.

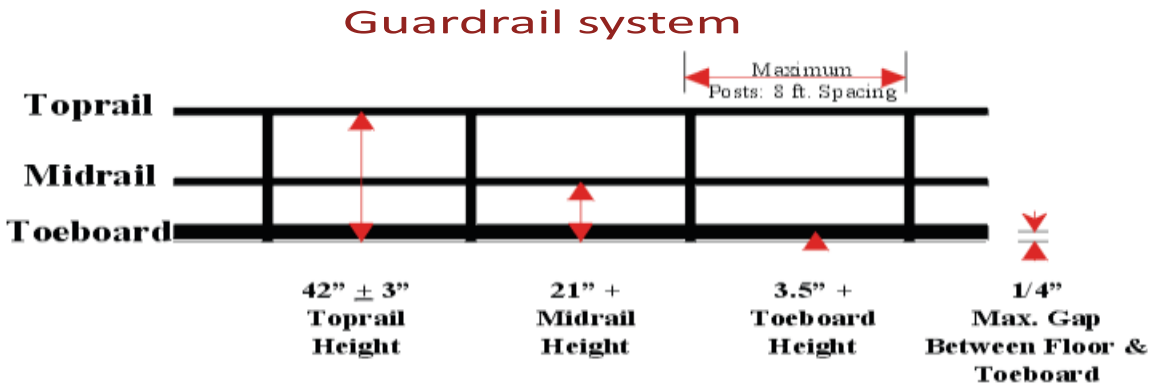



**Fig. 13.2.1.2 Guard Rail System**

viii. Guardrails shall be provided to protect workers from falling from elevated work places. The rails are generally made of MS pipes of suitable dia. Rebar shall not be used for any handrails, ladder or cover purpose. Wherever the guard-rails and toe-boards cannot be provided:

a. adequate safety nets or safety sheets shall be erected and maintained; or
b. adequate safety harnesses shall be provided and used and / or
c. adequate fall arrestor shall be provided and used.

As mentioned under PPE clause, all these PPEs shall be defect free and regularly inspected for any defect. The full body safety harness shall have double lanyard only with max 1.8m length.

ix. The monkey ladders shall have sufficient fall arrestors. Adequate lifelines of 8mm steel wire

rope shall be provided across the work area.

x. The HSE officer shall recommend appropriate PPEs after analyzing hazards and risks involved.

### 13.2.1.3 Scaffolding

All scaffolds shall be conformant to the relevant standards including IS 3696 and IS 4014 as applicable. A sketch of the scaffolds proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use.

**General**

1. The scaffolding work must be carried out by a competent person, who shall train the scaffold users on safety aspects
2. All scaffolds shall be erected / dismantled by scaffolding crew under direct supervision of competent scaffolding supervisors.
3. All scaffolds shall be capable of supporting 4 times maximum intended load and erected on sound, rigid footing, capable of carrying the maximum intended load without settling or displacement. Bamboo scaffolding is not permitted for use on site.
4. Each employee on the scaffold shall use an approved safety harness attached to an independent lifeline. The lifeline is to be securely attached to substantial members of the structure (not the scaffold itself) or to securely rigged lines, which shall safely suspend a worker in event of a fall.
5. Guard rails and toe boards shall be installed on all open sides and ends of platforms more than (2) meters above ground or floor
6. Scaffold planks must be at least 5 cm x 25 cm (2” x 10”) full thickness lumber scaffold grade or better.
7. Scaffold planks shall not span distances greater than 2.5 meters (8 feet).
8. Scaffold planks shall extend over end supports not less than 6 inches nor more than 12 inches and be secured to the scaffold. Scaffolding and accessories with defective parts shall be immediately repaired or replaced.
9. All scaffolding must be a minimum of two planks wide. No one may work from a single plank.
10. Scaffold planks must be inspected before use. Planks that have been damaged must be removed from the site.
11. Access ladders must be provided for each scaffold. Climbing the end frames is prohibited unless the design incorporates an approved ladder.
12. Adequate mudsills or other rigid footing capable of withstanding the maximum intended load must be provided.
13. Scaffolds more the 6 meters (20 feet) in height must be tied to the building or structure at intervals which do not exceed 4 meters (13 feet) vertically and 6 meters (20 feet) horizontally.
14. Do not overload scaffolds. Material should be brought up as needed. Scaffolding must not be loaded in excess of its rated capacity.
15. Barrels, boxes, kegs, blocks or similar unstable object must never be used as work platforms or to support scaffold.
16. Where persons must work under or pass under a scaffold then a 18 gauge wire mesh screen must be installed between the toe board and guard rail.
17. Employees exposed to overhead hazards while working on a scaffold will be protected by 5 cm (2”) thick planks.
18. Wooden/bamboo ladders shall not be allowed at any cost. Ladder’s rungs shall be fitted /welded properly. Before every use the rungs should be checked for safe use.

19. Wooden scaffolds shall not be used in areas where fire / fire products are expected
20. Ropes made of jute / Plastic and other fire prone material shall not be used to tie up scaffolding components together
21. The platform should have permanent hand rail and mid rail with Toe board without fail.
22. All platforms are to be tightly planked for the full width of the scaffold, except as may be necessary for entrance openings. Platforms shall be secured in place.
23. On suspension scaffolds designed for a working load of 500 pounds, no more than two workers are permitted to work on the scaffold simultaneously. On suspension scaffolds with a working load of 750 pounds, no more than three workers are permitted on the scaffold simultaneously.

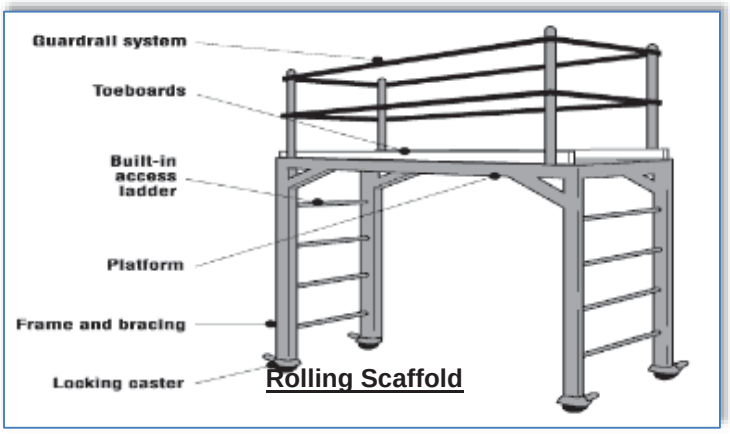
**24. Requirements for different types of Scaffolds:**

**A. Suspended Scaffold**

i. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
ii. Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

**B. Rolling Scaffolds**

i. The height of rolling scaffolds shall not exceed three times the minimum base dimension.
ii. The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).
iii. Adequate help must be provided when moving a rolling scaffold.
iv. Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.
v. No one is permitted to ride a rolling scaffold when it is being moved. Castor brakes must be locked-on when the scaffold is not being moved.



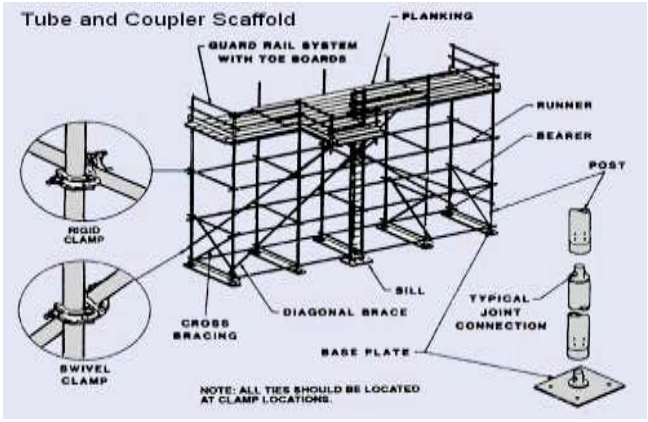




**Fig. 13.2.1.3 Types of Scaffolds**

**25. Scaffold Tagging**

Scaffolds being erected, modified or dismantled must be tagged as suitable for use. The scaffolds can only be accessed by those involved with the process.

**GREEN** scaffold tag- shall be fixed when scaffold is complete and safe for use, signed and dated by

the scaffolding competent person daily.

**RED** scaffold tag – to be fixed if scaffold is in some way defective and cannot be used or is still under erection.

Examples of scaffold tags:

**Fig. 13.2.1.4 Scaffold Tagging**

### 13.2.1.4 Ladder Safety

A sketch of the ladders proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use

**Safe Use of Ladders:**

1. Fall protection is required when working on a ladder above 2 meters and when climbing above nearby guardrails.
2. Ladders must be inspected prior to use and by a competent person quarterly, with documentation.
3. Use portable ladders for height up to 4 M only
4. Provide fixed ladders for height above 4 M
5. Place the ladder at an angle of 75 degrees (approx.) from the horizontal (1:4)
6. Extend ladder at least 1 M above the top landing
7. Secure top and bottom of the ladder firmly to prevent displacement- anti skid lining at the bottom
8. Ensure that the width of the ladder is not less than 300 mm and distance between rungs is not more than 300 mm
9. Provide landings of minimum size 600 x 600 mm at intervals not more than 6 M for fixed ladders. Check the ladders daily for any defects
10. Ensure that the areas around base and top of the ladder are clear. Getting on and off the ladder is more hazardous than using it. Use a mudsill if the ladder is to rest on soft, lose or rough soil
11. Do not use ladders of conducting material near power lines, and only use ladders near power

line or other energize system with exposed parts if they are confirmed locked-out and de-energized.

12. Stand no higher than the fourth rung from the top for carrying out any job standing on a ladder.
13. Never reach out from a ladder to perform work where your belt buckle protrudes past the ladder rung.
14. Always face the ladder while climbing up or down
15. Maintain three-point contact while climbing up or down a ladder i.e. two hands and one foot or two feet and one hand on the ladder at all the times.
16. Avoid climbing up or down a ladder while carrying anything in hands. Lift tools, equipment and materials with a rope.
17. Work from portable and extension ladders near guardrail where fall expose exists over the guardrail regardless of height, and above 2.0 mtr. heights from the working/walking surface will require the use of personal fall arrest equipment

### 13.2.2 EXCAVATION & CIVIL WORKS

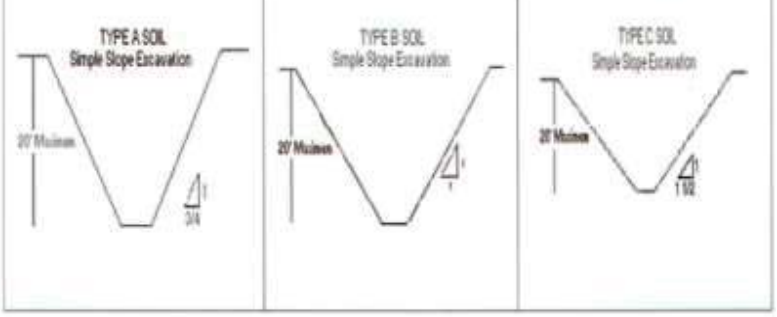
All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

#### 13.2.2.1 Excavation

The following safety measures are to be ensured before and during excavation:

1. All Excavation activities more than with depth of 1.22 meter or more shall require and Excavation Work Permit
2. Check for underground utilities like electrical / telephone cables, sewage, water lines and proper care has to be exercised to protect and prevent damage to it
3. Proper and adequate slope is maintained while excavating
4. Adequate shoring or sheeting is done wherever require to prevent soil sliding
5. Safe access through ladder or steps for exit & entry to excavation
6. No material /excavated soil is kept within one meter from the edge
7. Safe way is planned and provided for movement of HEM /transport equipment near excavation
8. Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works
9. Dewatering arrangement is made where water seepage is prevailed.
10. Stop blocks are provided to avoid vehicles reversing into the excavated trenches
11. Danger signs /Caution boards are displayed at work spot
12. Barricading is provided at excavated pits

| Soil Type | Height/Depth ratio | Slope Angle |
|---|---|---|
| Stable Rock | Vertical | 90 deg. |
| Type A | ¾ : 1 | 53 deg. |
| Type B | 1 : 1 | 45 deg. |
| Type C | 1½ : 1 | 34 deg. |




**Determining Soil Type**

| Type | Description | Examples |
|---|---|---|
| A | Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot or greater. | Clay, silty clay, sandy clay, clay loam and in some cases: silty clay loam and sandy clay loam. |
| B | Cohesive soils with unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf. | Angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases silty clay loam and sandy clay loam. |
| C | Cohesive soils with unconfined compressive strength greater than 0.5 tsf or less. | Granular soils such as gravel, sand and loamy sand; submerged soil or soil from which water is freely seeping; submerged rock that is not stable. |

**Fig. 13.2.2.1 Excavation Reference**

### 13.2.2.2 Piling

Ensure the following precautionary measures before starting piling works:

1. Inspection of piling equipment by responsible person for its condition before initiating piling operation.
2. Checklist and OCP for piling to be prepared using manufacturer's instructions and used
3. Testing and its certification wire ropes, slings, D-shackles, chain pulley blocks using in the process of piling work by competent person
4. Adequate support and secured foundation of the piling equipment to avoid toppling
5. Hoses should be lashed and adequately secured
6. Proper work platform is to be provided on piling frame
7. Safe work procedures and close supervision to prevent unsafe acts of operators/any unsafe conditions that may arise
8. Only experienced and trained operators are engaged for the piling operation
9. Provision of Personal Protective Equipment (PPE) like safety shoes/gumshoes/safety helmet/safety belt etc. and its use by their workmen.
10. Special care and precautions If work is near electrical live cables/ electrical equipment
11. Cordoning of work area to prevent un authorized entry
12. Guarding of revolving parts
13. Specific measures to prevent over turning of pile driver/missing of hammer/ hammer movement out of range

### 13.2.2.3 Batching

**Following Safety considerations for batching plant are to be ensured:**

1. Modern type batching plant should be used in which all the moving parts are protected and emergency and safety features are incorporated.

2. Installation of external Electric moto-vibrators in the feeding hopper of all batching plants to reduce human intervention.
3. Installation of safety devices like pull-chord on both the sides of conveyor for stopping the conveyor in emergency
4. Workers carrying cement / sand to be given appropriate PPEs like respiratory masks & gloves.
5. Conveyor belt/rotating parts must be guarded properly.
6. Safety awareness shall be inculcated in workmen about the risk involved in rotating parts.
7. The agency shall ensure to erect the batching plant as per drawing including installation of all safety devices as provided by manufacturer and witnessed by BHEL Engineer in charge before starting of machine in future.
8. Safety audit to also focus on Batching plant.
9. The site shall impose penalty on the agency who has violated the safety norms as per contract.

#### 13.2.2.4 Mobile Plant

Mobile plant includes tractors, trailers, dumpers, excavators, bulldozers, road rollers etc. for earthmoving purpose and concrete mixers, concrete transit mixtures, concrete pumps etc for concreting purpose. Due to the very nature of their function and movement in difficult terrains, congested areas, working in tandem with manual work and other operations the danger is inherent. Reverse horn is compulsory for all earth moving machineries.

**Following Safety measures to be ensured for Mobile Plant:**

1. Where movement around site is involved, routes should be planned, obstruction free and well maintained
2. Observe specified speed limits
3. Operating personnel should be aware of associated risks and its preventive measures
4. Only experienced, trained and authorized persons with valid license (wherever applicable) should operate the mobile equipment/vehicles
5. Provide and use Warning lights and reverse horn for cautioning the people around
6. Operation should be on level and stable ground with adequate working clearance.
7. Loading of out riggers/stabilizers should be well within safe ground bearing capacity
8. No person should be on equipment or vehicle during loading and unloading of material
9. Operators should be protected by warning barriers or switching off power when working in close proximity of overhead power lines
10. The equipment /vehicles should be well maintained and provided with effective brake system and other safety devices (wherever require)
11. Rotating parts of equipment should be adequately guarded
12. Provide necessary personal protective appliances and ensure its use by the operating personnel Ensure effective measures at source to control harmful emissions, dust, fumes contaminating atmosphere and cause health hazards to the operators and people in the vicinity.
13. No overloading/over stressing of vehicles/plant is allowed
14. Hoses, pipes, receivers, gauges and valves involved in carrying out hydraulic fluid/ compressed air should be checked for leaks and tested prior to operation.
15. Adequate safe clearance for swing and movement is to be judged during operation of Concrete mixer
16. Setting of machine on firm and level ground with wheel locked to prevent movement of machine
17. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket

18. Operator leaving work spot should ensure that the equipment/vehicle is kept in neutral position and place on firm and level ground.
19. The hand brake should be kept in position and block road wheels as additional safety measure
20. Blades/buckets should be kept low while moving
21. The dozer blades should not be used as brakes except in emergency
22. The ground should be examined for its bearing capacity and general safety especially when operating road roller at the edges of slopes, embankments.
23. The roller should not be moved downhill with the engine out of gear
24. If operating near excavations the following precautionary measures are to be ensured
25. Barricading, edge protection to prevent fall of persons/vehicles over running while reversing etc.
26. Suitable support system and adequate allowance to avoid the danger of side collapsing
27. Experienced signaler /attendant should be always accompanied with operator/driver for proper direction /signal and also to caution others in the working Zone during operation of mobile plant

#### 13.2.2.5 Concrete Vibrators

1. Revolving parts/belt drives should be adequately guarded and Vibrating unit shall be completely enclosed and have suitable overload relays and effectively earthed
2. Ensure sufficient length of cable to the Vibrator.
3. Ensure electric starters and other accessories are firmly fixed adequately supported
4. Ensure locking of needle load while inserting needle in to the vibrator,
5. Ensure periodical lubrication and maintenance

#### 13.2.2.6 Concrete Mixers

1. Setting of machine on firm and level ground with wheel locked to prevent movement of machine
2. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket

### 13.2.3 WELDING & GAS CUTTING SAFETY (HOT WORK)

1. All Hot Work shall require a Hot Work Permit
2. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced.
3. All safety precautions shall be taken for welding and cutting operations as per IS-818.
4. When possible, items to be welded, cut, heated, etc. shall be moved to a safe location free of combustible or flammable material. If this is not possible, then all combustibles/ flammables that can be removed from the area shall be removed within a 35-foot circumference and a positive means of confining arcs and sparks generated by the process shall be ensured and additional person(s) shall be stationed as fire-watch for the area(s)still exposed, along with obtaining the Hot Work Permit as applicable.
5. Appropriate fire-fighting equipment is to be available in close proximity of any welding and gas cutting operations at all times suitable for the type of Fire.
6. Drums, tanks, and similar containers that have contained flammable or toxic material shall not be welded, cut, or heated until they have been made safe by water filling, thorough cleansing or similar accepted practices. The container shall also be ventilated during the welding, cutting, or heating process.
7. Proper ventilation is required for any welding or torch operations performed in a confined space.
8. Any welding or gas cutting operations performed on metals of toxic compounds or coating such as zinc, stainless steel, lead, cadmium, chromium, and beryllium shall be properly ventilated

and/or proper respiratory protection shall be worn by any person that could be exposed to fumes, vapors, and gasses created by the welding and gas cutting processes.

9. Wherever it is practical, all arc welding operations shall be shielded to prevent direct light rays or sparks from contacting persons in the vicinity or from reaching areas normally used to travel through or into the vicinity. Where this is not practical, persons who shall be in the area are to use proper eye and skin protection. Other persons who are not participating in the welding or gas cutting operations are not to be allowed into the hazard zone.
10. Welders and other employees who are exposed to arc welding radiation shall wear suitable clothing and protective apparel to prevent burns and other types of ultraviolet radiation damage to the skin.
11. Arc welding machines shall be shut down when being moved or when they are not in continuous use. Electrode holders left unattended shall have electrodes removed and shall not be left where they might contact employees or conducting objects.
12. Arc welding power supply cable shall be of proper rating and material, e.g. copper.
13. Welders shall guard against allowing materials adjacent to or behind them to reflect radiation back toward them or towards others in the area. Reflected radiation can cause skin burns and eye flash burns.
14. Valve caps shall be in place when cylinders are not in use. Valve caps shall never be used for lifting the cylinder vertically.
15. Torches shall only be lit by approved strikers; never with matches, cigarette lighters, or hot-work.

16. **Splatter / Slag Collector**

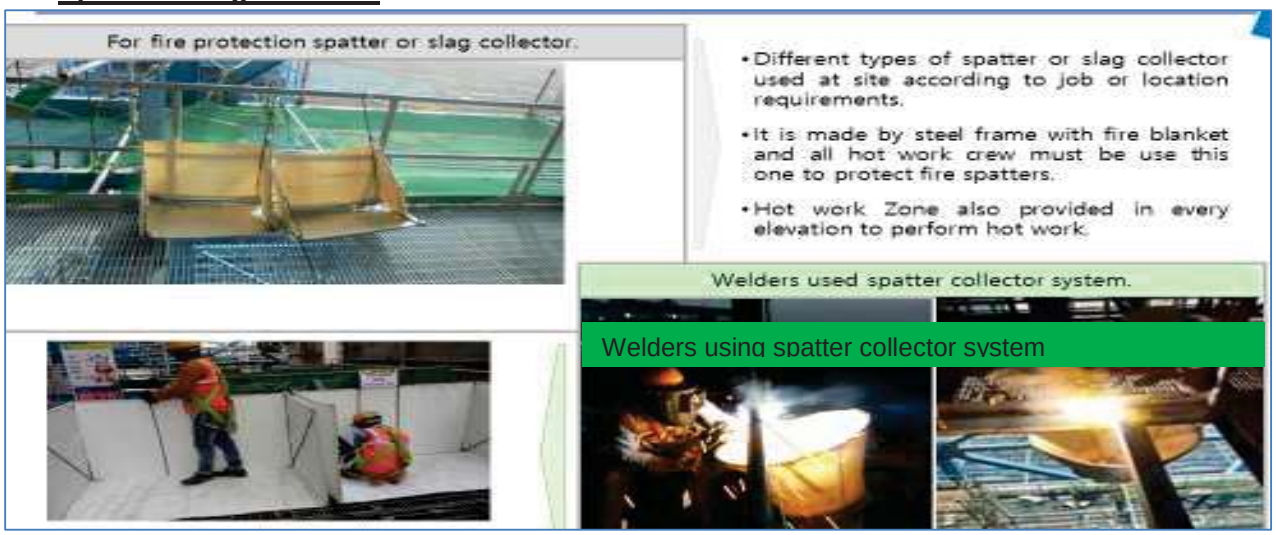



**Fig. 13.2.3.1 Splatter / Slag Collector**

While carrying out job at height, the sparks or molten slag shall be prevented from falling down by putting a fire-resistant (non-asbestos) sheet or patter/ slag collector or even MS Sheet. The passage of falling sparks or molten slag shall be barricaded till ground floor and any cable/ tubes/ any other objects interfering in the passages hall either be removed or covered with Fire-resistant sheet or MS

Sheet.

### 13.2.3.1 COMPRESSED GAS

1. All cylinder valves shall be closed when any work is finished and when any Cylinders are empty or being moved. Valve protection caps shall be placed and secured properly before gas cylinders are transported, moved or stored.
1. Compressed gas cylinders shall be secured in an upright position with chain or appropriate means during storage & use. However, a trolley shall be used for transportation.
2. Compressed gas cylinders shall always be secured from tipping or falling, whether in use, in storage or in transit. The cylinders shall always be secured upright, except during times when actually being hoisted or carried.
3. When cylinders are transported by powered vehicle they shall be secured in a vertical position.
4. Regulators shall be removed when cylinders are not in use or are in transit, unless the cylinder is firmly secured on a special carrier designed for this purpose.
5. Gas cylinders are not allowed to be used in man-basket when occupied.
6. Cylinders containing oxygen or fuel gasses shall not be taken into confined spaces.
7. Oxygen cylinders shall be stored a minimum of 6 meters from fuel gas cylinders or shall have an approved firewall between them.
2. All cylinders shall be kept at a safe distance from welding or cutting operations or shielded from arc/ sparks / slag.
3. All cylinders shall be placed where they cannot become part of the electrical circuit.
4. Oxygen and acetylene shall not be stored together. Oxygen must be separated from acetylene (or ANY fuel gas) or combustible material by at least 20ft or a barrier with a 30 minute fire resistance rating.
5. All Cylinders should be stored upright in a designated area with labels for the type of gas. All applicable precautions to be ensured during storage
6. Oxygen and fuel gas regulators, hoses and associated equipment shall not be altered and shall be in proper working order while in use.
7. Compressed air can be extremely dangerous if allowed to penetrate the skin. As such, the use of compressed air to clean off yourself or other workers shall be strictly prohibited.
8. All gas cylinders shall be stored in upright position. Suitable trolley shall be used for cylinder movement, the design of which shall be submitted to BHEL Engineer for approval.
9. No of cylinders shall not exceed the specified quantity as per OCP
10. Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.
11. All cylinder should be kept only in cylinder trolley.
12. Cylinder shall be transported in upright vertical position by suitable mean.

### 13.2.4 LIFTING & RIGGING SAFETY

1. All Heavy / Complex Lifting operations as defined in Clause 6.12 shall require a Lifting Work Permit.
2. All the cranes and lifting tools & tackles shall be inspected on daily / weekly basis as well as monthly by expert as per applicable formats.
3. In addition, inspection / certification as mandated by law shall be carried out wherein these shall be tested and certificates of fitness shall be obtained from 3rd party State Govt. approved competent agency before deploying at site and later periodically. BHEL shall be given advance intimation of any such inspections
4. The last date of Third Party Inspection and the next Due date shall be conspicuously displayed on all cranes. A copy of certificate shall be pasted on operator's cabin of all the lifting equipment.
5. Following requirements shall be mandatorily followed, wherever applicable:
   a. The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed.
   b. All tools tackles, lifting appliances; material-handling equipment etc. used by the subcontractor shall be of safe design and construction.
   c. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices".
   d. There shall be a person responsible for co-ordination among cranes where multiple cranes are used, and lifting over 75% of the crane capacity to be avoided.
   e. Mobile phone should be banned for crane operator and lifting operation. Only walki talki shall be allowed in rigging/Lifting purpose.

#### 13.2.4.1 Personnel Lifts (Man-Basket / Jhoola):

The design of personnel man basket shall be submitted to BHEL Engineer for approval before use. Relevant permit (Height work & others as applicable) shall be completed prior to lifting any people, along with a rigging plan.

a. A separate Lifeline / Fall arrestor anchored to a fixed structure outside of Jhoola shall be provided for the workers inside the basket. All occupants of the basket shall have Safety Harnesses equipped with rope grabs, which are to be hooked to the vertical lifeline.
b. Man-basket shall be used where access through ladders or scaffolding is not feasible.
c. Man-baskets shall be designed and engineered by a manufacturer (job made man-baskets are not allowed, unless designed and tested by a certified engineer), and built robust with MS Angles and flats or plates or channels only.
d. Guard rails top and mid, must be in place and screened-in to avoid material from falling out of basket. The factor of safety shall be 200%.
e. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket.
f. The man-basket shall be thoroughly inspected and load tested and a trial run performed without personnel before being put to job.
g. It shall be treated as a lifting tool (T&P Item) and shall undergo same certification cycle and

inspection as other lifting equipment.

h. An additional sling of required lifting capacity shall be fixed the man-basket main lifting point and attached to the crane above the ball or block.
i. While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing.
j. Once man-basket reaches the destination, the lift brakes shall be locked as long as the basket remains at that point. The same care shall be taken in its descent.
k. As for hanging man-basket, the same shall be hung off a rigid structure with help U-shaped handle welded to man-basket. This shall be tested once in a year by a competent person.
l. Use of Rebar steel for making and monkey-ladder must be avoided.

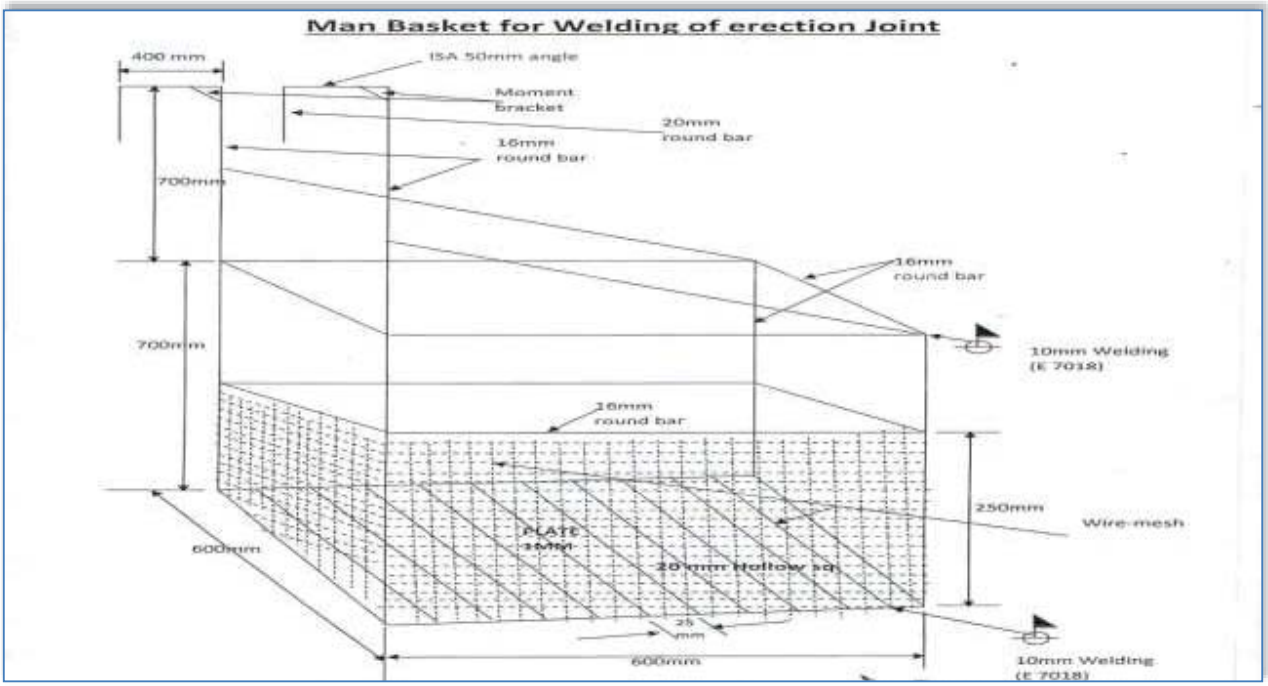



**Fig. 13.2.4.1 Man Basket for Welding Erection Joint**

13.2.4.2 **Cranes & Hoisting Equipment:**

This section provides the guidelines to ensure proper rigging and lifting activities are accomplished safely and in accordance with applicable specifications, codes, and regulations.

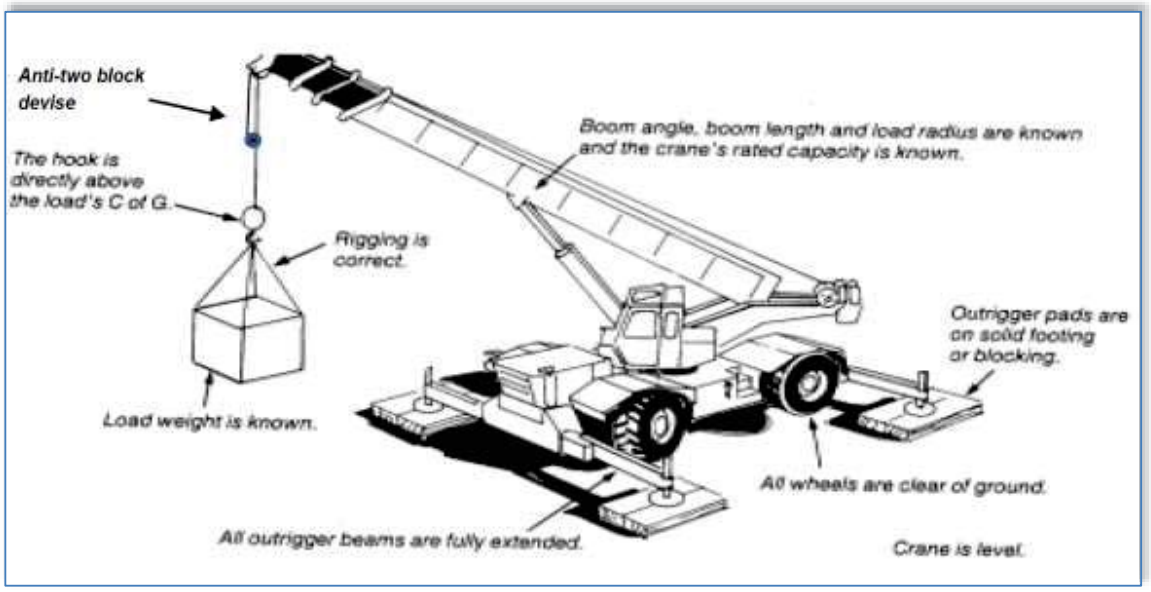



**Fig. 13.2.4.2 Proper Crane Setup**

a. On every crane or piece of hoisting equipment notices of all rated load capacities, recommended operating speeds, and any hazard warnings or special instructions shall be conspicuously posted. All instructions and warning shall be visible from the equipment operator ‘s station.
b. Cranes shall have an Anti-Two-block safety device installed
c. All mobile cranes shall have overload and backup alarms, load angle indicators and limit switches
d. All areas within swing radius of cranes that are potentially accessible by pedestrian, vehicular, or equipment movement shall be barricaded to prevent anyone or any vehicle or equipment from being struck by the crane or hoisting equipment, or its load(s).
e. No part of the lifting equipment or its load shall be within the distance as specified in the Indian Electricity Act from an energized power line
f. Cranes shall have annual certified third party inspection and be inspected before use by the operator. Any defects shall be corrected before use. Logs of crane inspection shall be kept with the crane.
g. Make certain that the rigging personnel, material, and equipment have the necessary capabilities for the job and are in safe condition.
h. Communicate with person(s) directly responsible for accomplishing the work and / or work area to establish requirements/responsibilities and make certain that all preparatory work is complete.
i. Mats/Pads must be used on all lifting equipment, equipped with out riggers.
j. Pick and carry must have the load secured to the rig in front.
k. Only BHEL Approved Plate Lifting Spreader Beam configuration shall be used (Sample in Fig. 13.2.4.2)

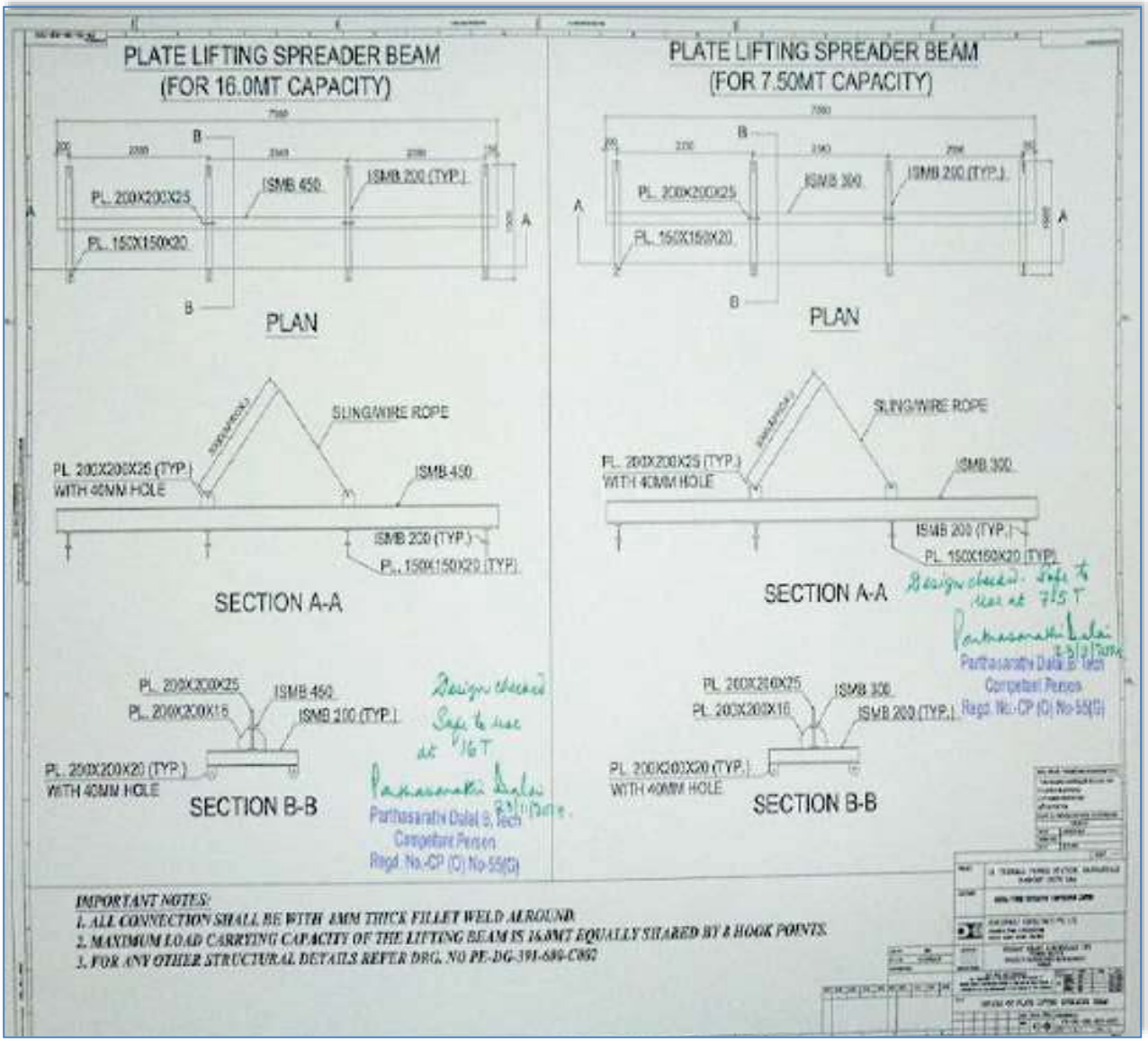



**Fig. 13.2.4.3 Typical Plate Lifting Spreader Beam Configuration for 7.5 MT and 15 MT Loads**

**I. Crane operators must follow the following:**

1. Pass an annual Operator's Physical examination
2. Carry a valid training certification card at all time while operating issued by the Govt. or other recognized institute.

### 13.2.4.3 SAFE RIGGING PRACTICES

13.2.4.4

a. Review the planned operation and requirements with the operator and rigging crew.
b. Ensure a pre-lift meeting is conducted with crane operator, tagline operator, signal personnel, and Safety Manager.
c. Designate a qualified person from the rigging crew to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desire clearance by visual means.
d. Clear the lift area of all unnecessary personnel.
e. Hydras shall only be allowed for loading & unloading works & shall not be allowed to move with load

#### 13.2.4.4.1 RULES FOR SAFE RIGGING

1. Use loops, thimbles and corner pads to prevent damage to slings when used around corners or on cutting edges.
2. Never allow wire rope to lie on the ground for any length of time or on rusty steel or near solvents, chemicals or corrosive substances.
3. Slings must not be pulled from between or under loads with load resting on the sling.
4. Keep all rope away from flame cutting or welding operations.
5. Never use rope as sling material.
6. Never wrap a wire rope completely around a hook.
7. Do not bend wire rope near any attached fitting.
8. The sling must be selected to suite the most heavily loaded leg rather than the total weight when using multi-legged sling to lift loads in which one end is heavier than the other.
9. When using 3 and 4 legged sling configurations, any two legs must be capable of supporting the entire load.
10. Where possible, wire rope choker hitches must include a shackle with the eye around the shackle pin to prevent breaking wires of the choke. The choker hitch must be “snugged down” prior to lifting, not after tension is applied.
11. Unless authorized by the hook manufacturer when more than two rope eyes are placed over a hook, install a shackle, pin resting in the hook, and place the rope eyes in the bowl of the shackle.
12. Properly rig all loads to prevent dislodgment of any part.
13. Use guide ropes or tag lines to prevent the rotation or uncontrolled motion of the load when necessary.
14. Loads must be safely landed and properly blocked before being unhooked and unslung. Tag lines must not be used in situations that jeopardize the safety of the lift.
15. Lifting beams must be plainly marked with their weight and designed working load and must only be used in the manner for which they were designed.

16. The hoist rope or chain must never be wrapped around the load. The load must be attached to the hook by slings or other rigging devices that are adequate for the load being lifted.
17. Multiple part lines must not be twisted around each other.
18. The hook must be brought over the center of gravity of load before the lift is started.
19. If there has been a slack rope condition, determine that the rope is properly seated on the drum and in the sheaves prior to lifting.
20. Keep hands away from pinch points as the slack is being taken up.
21. Leather gloves are recommended when handling wire rope.
22. Avoid impact loading caused by sudden jerking when lifting or lowering. Lift the load gradually until the slack is eliminated.
23. Never ride on a load that is suspended.
24. Avoid allowing the load to be carried over the heads of any personnel.
25. Never work under a suspended load until the load has been adequately supported from the floor and all conditions have been approved by the supervisor in charge of the operation.
26. Never leave a load suspended unless emergency evacuation is required.
27. Never make temporary repairs to sling.
28. The capacity of a sling is determined by its angle, construction, type of hitch and size.
29. Never lift loads with one leg of a multi-leg sling until the unused legs are made secure.
30. Never point load a hook unless it is especially designed and rated for such use.
31. Make certain that the load is broken free before lifting and that all legs are taking the load.
32. When using two or more slings on a load make certain all slings are made from the same materials.
33. Lower the loads on to adequate blocking to prevent damage to the slings.
34. Materials and equipment being hoisted must be loaded and secured to prevent any movement which could create a hazard in transit.
35. The weight of the hook, load block and any material handling devices must be included when determining crane capacity.
36. Calculated weights cannot exceed 75% of the chart without written approval.
37. Personnel must be completely clear of loads being picked up or set down by crane. Tag lines will be used to control the loads. Loads must not be touched by hand while placing/ moving.

#### 13.2.4.4.2 SLINGS

### a. Synthetic Slings

The following are rules for safe use of synthetic slings:

i. Synthetic slings must be marked to show the rated capacity for each type of hitch and type of web material.
ii. Nylon web slings must not be used where fumes, vapors, sprays or mists or liquids of acids or phenolic are present. Web slings with aluminum fittings must apply in this category.
**iii. Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:**

a. Acid or caustic burns
b. Melting or charring of any part of the sling surface
c. Snags, punctures, tears or cuts
d. Broken stitches
e. Distortion of fittings
f. Synthetic web slings of polyester or nylon must not be used at or come in contact with temperatures in excess of 82°C
g. Polypropylene web slings must not be used at or come in contact with temperatures in excess of 93°C
h. Insulated hooks must be tested yearly to insure insulation integrity to at least manufacturer's specifications.

**iv. Wire Rope Slings must be removed from service and destroyed if any of the following conditions are present:**

a. In (10) randomly distributed wires broken in one (1) rope lay, or five (5) broken wires in one (1) strand in one (1) rope lay.
b. Wear or scraping of one-third the original diameter of outside wires.
c. Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure such as:
d. Evidence of heat damage.
e. End attachments that are cracked, deformed worn.
f. Corrosion of the rope or end attachments.

**v. Metal mesh slings must be immediately removed from service if any of the following conditions are present:**

a. A broken weld or broken brazed joint along the sling edge.
b. Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion.
c. Lack of flexibility due to distortion or corrosion.

**vi. Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:**

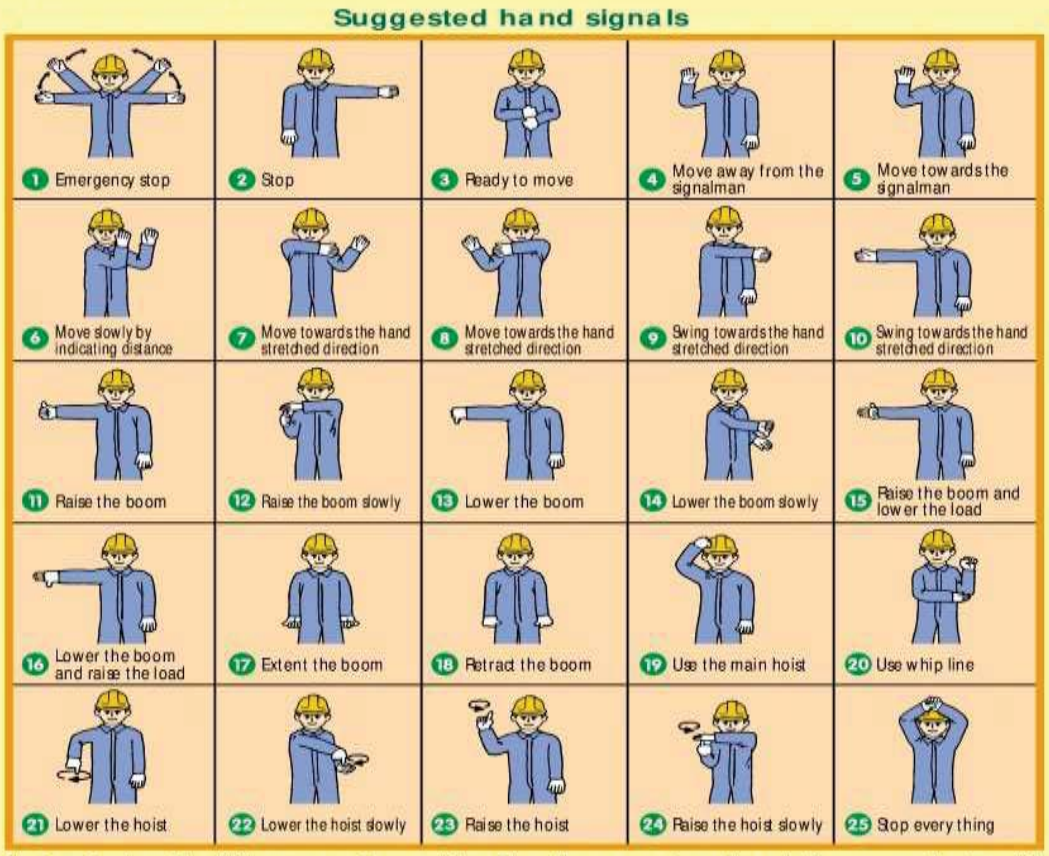
a. Acid or caustic burns
b. Melting or charring of any part of the sling service
c. Snags, punctures, tears or cuts
d. Broken stitches
e. Distortion of fittings

### b. Requirements of Plate Clamps:

1. The rated load of the plate clamp must be marked on the main structure.
2. Care must be taken to make certain the load is correctly distributed for the plate clamp being used.
3. Do not allow load or plate clamp to come into contact with any obstruction.
4. The plate clamp must not be used for side pulls or sliding the load.
5. When lifting stainless steel or special alloys, ensure plate clamp is designed for use on the specific metal.

### 13.2.4.4.3 SIGNALING PRACTICES:

- The "slinger" is responsible for attaching and detaching the load to and from the crane. He shall:
  - have received appropriate training on general safe lifting operations;
  - be capable of selectings lifting gears suitable for the loads;
  - liaise with the operator and direct the movement of the crane safely.
- The "signaller" is responsible for relaying the signal from the slinger to the crane operator. He shall:
  - have received appropriate training on general safe lifting operations;
  - be able to direct the movement of the crane and loads.




**Note: During the lifting operation, either the slinger or signaller shall communicate with the operator. Other communication methods (e.g., wireless walkie-talkies, telephones, etc.) may also be used.**

**Fig. 13.2.4.4 Recommended Signalling Practices**

### 13.2.5 DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured, besides using the Work Permit:

1. All roads and open areas adjacent to the work site shall either be closed, suitably protected or restricted for movement
2. No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.
3. All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

### 13.2.6 T&Ps General

1. All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test /calibration certificates bearing endorsement from competent authority of BHEL.

2. Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.

3. Tagging and punching in all lifting tool is compulsory with SWL, sr. no. and due date.

4. All T&Ps shall be inspected by authorized Third Party agency as per applicable frequency. BHEL shall be kept informed of any such scheduled inspection

5. All T&Ps shall be internally inspected in each quarter and colour coded as below.

### 13.2.6.1 T&P Color Coding Procedure:

Inspections and tests shall be documented by means of color coding which shall verify that inspections or testing are current and that all receptacles, portable Power tools, Lifting Tools & Tackles have been inspected and tested as required. The color codes used on the project shall be:

| GREEN | BLUE | YELLOW | RED |
|---|---|---|---|
| January<br>February<br>March | April<br>May<br>June | July<br>August<br>September | October<br>November<br>December |

**Table. 13.2.6.1 T&P Color Coding Procedure**

i. The cycle of colors shall be Quarterly as a minimum or as decided by BHEL. The color code tape / Sticker shall be clearly visible to designate the period for which the inspections and tests were conducted.

ii. Following the initial inspection, the equipment must be color-coded quarterly as per color-coding instructions that will be issued by the subcontractor.

iii. Fire extinguisher with the current month color-coding inspection sticker must be provided and secured in the platform.

iv. All slings shall be regularly inspected in accordance with the requirement of the project for frequent and periodic inspections and discard immediately if they fail to meet the minimum requirements of the project.

v. The Subcontractor's Safety Officer shall ensure that all PPE is inspected prior to its issue. He is to ensure all subcontractor personnel are using safe and proper PPE equipment. Regular inspections on the PPE shall be carried out and personnel not adhering to those inspections shall be removed immediately from the site.

vi. A five (10) day interval period shall be given into each monthly color code change. During this five (10) day period either color shall be acceptable.

### 13.2.7 CHEMICAL HANDLING

1. Displaying safe handling procedures & MSDS for all chemicals such as lube oil, acid, alkali, sealing compounds etc, at work place.
2. Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.
3. The used containers of chemicals shall be segregated and disposed off suitably
4. In case the used containers need to be re-used, all traces of the chemical to be removed by thorough cleaning with detergents etc. under trained supervision

### 13.2.8 ELECTRICAL SAFETY

1. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
2. Power supply to all equipment at site to be routed through MCBs of appropriate rating. A 'Power Supply Distribution Plan' shall be prepared and submitted to BHEL Engineer for approval

3. All power supplies through cables shall be underground or overhead with height > 3mtrs.
4. All distribution boxes shall be locked and the key controlled by site management of concerned subcontractor.
5. All individual equipment & tools at site shall be powered through Earth Leakage Circuit Breakers of 30 mA sensitivity.
6. These MCBs and ELCBs shall be regularly tested as per Clause 14
7. All fuses and fuse wires shall be of standard size and rating.
8. All electrical appliances used in the work shall be in good working condition and shall be properly double earthed other that armour earthling.
9. All extension boards shall have separate switches for all sockets / connections
10. All portable electric tools used by the subcontractor shall have safe plugging system to source of power and be appropriately earthed.
11. Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts especially in confined spaces like inside water boxes, turbine casings, condensers etc.
12. Electrical appliance shall have proper earthing and for appliances equal to & more than 415V shall have two separate earthing (as per IS-3043-1987)
13. Details of earth resource ad their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
14. The subcontractor shall use only properly insulated and armoured cables and conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.
15. BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the risk & cost of the subcontractor.
16. No maintenance work shall be carried out on live equipment
17. Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public
18. The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.
19. Wiring and Branch Circuits Must be protected by a proper amperage over-current device such as a HRC fuse or circuit breaker. Such installations must be located so as to prevent physical damage to the wire conductors & panels.

**20. Portable Electric Lights**

a. Portable electric lights used in wet or potentially wet locations must be either low voltage type (24 volts or less) or protected by a GFI (ground fault interrupter).
b. They must be visually checked before each use and periodically while in use to assure their original integrity is maintained.
c. Cords with cuts, breaks, deep abrasions, etc. shall be taken out of service immediately.
d. Repairs to extension cords shall only be performed by qualified/ licensed electricians.
e. Must not be allowed to lie in wet or potentially wet areas.

**21. Underground Cables:**

a. Every electric line or cable of unknown origin that is discovered or exposed during a digging, drilling, probing, or similar operation is to be considered as energized and life threatening.
b. The senior company employee on the site will ensure that all necessary safety precautions are taken in order to isolate the line from all workers and the public.
c. Such precautions may include halting the operation if appropriate.
d. The senior company employee on the site is to then contact the proper authorities to have the line identified and either confirmed to be abandoned and/or made safe for continuing the work.
e. Any and all underground lines that are discovered or become severed must be considered energized on both sides, and be treated accordingly.

22. In general, equipment or machinery being moved or transported must maintain minimum clearances of 25 ft. to all power lines.
23. TAG IN/ TAG OUT must be in force in Switch Room and all Distribution Boxes for live power line. The authorized person's name and contact no shall be displayed
24. Ensure "double insulated" three - core cables and three pin connectors are used and are properly ground "all insulated" types, all electrical tools and appliances must be manufactured for industrial use.
25. All connections shall be electrically and mechanically sound and properly insulated. Taped joints are not permitted. Connections to socket outlets must be made with proper plugs.
26. Splices in electrical cords are not permitted. Repairs must be made at the socket connection and retain the same mechanical and dielectric condition of the original connection.
27. Damaged or defective electric tools, equipment and extension cords, etc. must not be used and shall be tagged out of service, removed from the work area and taken back to stores.
28. Only licensed electricians are authorized to repair and work on electrical equipment. Tampering with electric tools or equipment by others could result in termination.
29. Temporary electric cabling should be elevated 2.2 meters above the floor/ground or covered for protection. It must be kept clear of walkways and other locations where it may be exposed to damage or create a tripping hazard.
30. Energized wiring in junction boxes, circuit breaker panels and similar places must be covered and locked at all times.
31. Areas with live high voltage wires or terminals must be barricaded against entry and warning signs posted Danger – High Voltage and Authorized Personnel Only.
32. Personnel should never work on energized equipment, de-energizing (lockout/tag out) the equipment is always the first requirement.
33. The lockout and tag out procedure will be used when testing or working on, or around, energized installation.
34. Working around energized equipment should never be done alone. A second electrician must always be available for assistance.

35. If lockout/tag out of the work is infeasible (must be demonstrated), work on energized electrical circuits must be approved by the Site In-charge. All safety precautions necessary must be taken, PPE use must be evaluated per the exposure and used, i.e high/low voltage gloves, insulated shoes, overcoats/aprons, face shields, and other protective equipment like insulated tools, blankets, mats, etc. must be used.
36. The welding machines earth leads shall be properly fixed without loose contacts. The earth cable only has to be used. No steel members shall be used as earth leads.
37. Electrical crews must be qualified for the equipment and tools they work on, including being trained in Cardio-Pulmonary Resuscitation (CPR) methods and First Aid for rendering help in the event of electric shock.

**38. Qualified Persons for Electrical Works**

One who is trained and wiremen licensed to Govt of State and familiar with the construction, operation and safety hazards of the equipment upon which they are permitted to work.

i. Qualified persons are intended to be only those who are well acquainted/experienced with and thoroughly conversant in the electric equipment and electrical hazards involved with work being performed.
ii. Only qualified persons may be permitted to work on or near exposed energized parts. Such persons are required to have been trained in three specific areas:
iii. Qualified persons must be capable of working safely on energized circuits;
iv. Must be familiar with the proper use of special precautionary techniques and procedures bases on equipment and exposure; and
v. Must be familiar with required personal protective equipment, insulating and shielding materials, and insulated tools.
vi. Qualified persons are expected to be able to evaluate unknown situations and adjust their activities in such a way that only safe work practices are used. Such behavior is the responsibility of the qualified person.
vii. It is possible and likely for an individual to be 'qualified' with regard to certain equipment in the work place, and unqualified on other equipment they must know their limitation and stop work if not qualified on what equipment they were to work on.
viii. An employee who is undergoing on-the-job training, who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training, and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties. The process must be documented as proof.

## 13.2.9 USE OF HAND TOOLS AND POWER-OPERATED TOOLS

### 13.2.9.1 General Provisions

a. All hands and power tools and similar equipment, shall be maintained in safe condition.
b. When power operated tools are designed to accommodate guards, they shall be equipped
c. with such guards, when in use;
d. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;
e. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases shall be

provided with the particular personal protective equipment necessary to protect them from the hazards;

f. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive on-off control.
g. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

### 13.2.9.2 Hand Tools

a. The subcontractor shall not issue or permit the use of unsafe hand tools;
b. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs;
c. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;
d. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

### 13.2.9.3 Power Operated Tools

a. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;
b. The use of electric cords for hoisting or lowering loads shall not be permitted;
c. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming incidentally disconnected;
d. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being incidentally expelled;
e. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm2 pressure at the tool a safety device on the muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface;
f. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm2 and that too with effective chip guarding. The 2 kg/cm2 pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes;
g. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;
h. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;
i. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's

recommended procedure;

j. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired;
k. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end;
l. Loaded tools shall not be left unattended;
m. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles;
n. Driving into materials that can be easily penetrated shall be avoided unless backed by a
o. substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
p. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
q. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
r. All tools shall be used with the correct shield, guard or attachment as recommended by the manufacturer.

### 13.2.9.4 Abrasive Wheels and Tools

a. All grinding wheel must be ISO certified only.
b. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
c. Grinding machines shall be equipped with suitable safety guards;
d. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 900, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 1200. In either case, the exposure shall begin not more than 8.650 above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel;
e. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel;
f. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
g. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of incidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 1800;
h. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
i. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of incidental breakage, shall be used;
j. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that

they are free from cracks or defects;

k. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place;
l. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

### 13.2.9.5 Wood Working Tools

a. All fixed power driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the off-position;
b. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is re-tensioned for a different speed, the marking shall be corrected to show the new speed;
c. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points;
d. All portable power driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

### 13.2.10 START UP, COMMISSIONING AND TESTING:

There are various activities involved prior to commissioning- the major ones are -Hydraulic Test, Steam Blowing, Transformers Charging, Boiler Light Up, Rolling and Synchronisation and Full loading of unit.

a. These activities shall be personally supervised by the site executive along with the commissioning engineer.
b. Appropriate Work Permits shall be taken as applicable
c. The readiness of upstream and downstream system shall be ensured before taking up.
d. These shall be handled strictly by the authorized persons only and the team shall be suitably briefed about the activity including hazards & risks involved and control plan by the concerned executive-in-charge before start.
e. Entry of persons to the area of activity shall be suitably restricted and the emergency functions like Ambulance, first aid center and Fire station shall be intimated about the plan well in advance.
f. Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary.
g. Electricians with valid wiremen license only shall be permitted to work on power lines.
h. The area and the passage shall be adequately illuminated.

### 13.2.11 FIRE SAFETY

Numbers and types of Fire Extinguishers shall be ensured as follows:

| Sl. No | Type of Fire Risk (Class of Fire) | Extinguishing Medium & Relevant Indian Standard | Scale of Equipment (Minimum recommended) |
|---|---|---|---|
| 1. | **CLASS 'A'**<br>Fires involving ordinary combustible materials like wood, paper, textiles, rubber etc. (Ordinary hazard or low fire load) | WATER Soda acid type, water type (gas pressure) and water type (constant air pressure)<br>IS: 934 -1976; IS: 940 -1976; IS: 6234 -1971 | For every 600 square meter floor area or part, one 9-litre capacity. Minimum 4 numbers per floor or room; should not be required to travel more than 15 meter to reach any extinguisher. |
| 2. | **CLASS 'A'**<br>(Extra hazard & high fire load) | -do | -do –<br>(Also, consult local fire authority). |
| 3. | **CLASS 'A'**<br><br>(Special hazards) | -do | -do –<br>Extra provision<br>For every 100 square meter floor area or part, one 4.5 Kg. CO2; minimum 2 numbers per room; should not be required to travel more than 10 meter to reach any extinguisher. |
| 4. | **CLASS 'B'**<br>(Fires in flammable liquids like oils, solvents, petroleum, products, varnishes, paints, etc. where blanketing effect is essential) (Storage and handling in small quantities) | FOAM / CARBON DIOXIDE / DRY CHEMICAL POWDER IS: 933 -1976; IS: 2878 1976; IS: 2171 1976; IS: 4308 -1982 | For every 50 square meter floor area or part, 2 numbers 9 -liters foam or 5 kg dry powder; should not be required to travel more than 10 m in the area of storage to reach any extinguisher. |
| 5. | **CLASS 'B'** (Bulk storage other than in tank form) | -do - | -do-<br>(but minimum 3 numbers per room) |
| 6. | **CLASS 'C'**<br>(Fires involving gaseous substances under pressure where it is necessary to dilute the burning gas at a very fast rate with an inert gas or powder) (locations of storage and handling of gas cylinders) | CARBON DIOXIDE / DRY CHEM. POWDER. The best way to extinguish such fire is by stopping the flow of fuel gas to the fire. Container is kept cool with water spray. IS: 2878 1976; IS: 2171 -1976; IS: 4308 -1982 | For every 100 square meter floor area or part; 2 numbers, 10 kg powder extinguisher or 6 kg C02; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher. |
| 7. | **CLASS 'D'**<br>Fires involving metals like magnesium, aluminum, zinc, potassium etc. where the burning metal is reactive to water and which require special extinguishing media or technique | SPECIAL DAY POWDER IS: 2171 -1976 IS: 4861 -1968 | For every 50 square meter floor area or part, 2 nos. 5 kg special dry powder; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher. |
| 8. | **MIXED OCCUPANCY**<br>(electrical); Generators; Transformers; etc. | CARBON DIOXIDE DRY POWDER, IS: 2878 -1976; IS: 2171 -1976 | For every 100 square meter floor area or part one 10 kg C02. Minimum 2 numbers for every location should not be required to travel more than 10 meter to reach an extinguisher. |
| **Note**: Due to peculiarities of the power plant construction sites, there would be locations in the construction areas of Boiler, Turbine, Generator, Transformer, etc. where different types of fire risk (classes of fire) may co-exist. Special | | | |

care shall be taken while selecting and installing portable fire extinguishers for such locations so that all types of fire risk that may co-exist, are adequately covered. Similar special care shall be taken for storage areas.

1. All Electrical welding booths shall be equipped with appropriate Fire Extinguisher
2. Appropriate Fire Extinguishers shall be made within easy reach of all welding operations
3. Fire extinguishers shall be regularly tested and last checked date to be indicated on each.
4. Providing appropriate firefighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
5. Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labour colony etc. Such fire protection equipment shall be easy and kept open at all times.
6. The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
7. All other fire safety measures as laid down in the “codes for fire safety at construction site” issued by safety coordinator of BHEL shall be followed.
8. Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
9. Emergency contacts nos. must be displayed at prominent locations
10. Tarpaulin being inflammable should not be used (instead, only non-infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.

### 13.2.12 HSE PREPAREDNESS FOR ADVERSE CLIMATES AND WEATHER

Subcontractor to remain updated on possible adverse weather conditions through reliable sources and all precautions taken accordingly.

#### 13.2.12.1 SUMMER

1. The Working Time and Lunch Hour will be as per instruction of Statutory Authorities (no work between 11am to 3:30pm). However, in case temp comes down due to rain/cloudy weather work will continue as per normal routine.
2. During long lunch break, worker will be allowed to go back home for rest. Those who will like to stay back will avail at the facility of rest shed or other designed area.
3. They will be allowed to take small break during work as per their need.
4. Water sprinkling will be done on roads to reduce dust concentration.
5. Workers will be provided with adequate cool drinking water and Butter milk/Lemon water etc.
6. Adequate ORS stock will be made available at the work location in the First-Aid Box for use as needed and at First-aid Center for emergency need.
7. Fire prevention shall be on high alert, with removal of dry grass and bushes, etc, inside and outside the surrounding work areas. No smoking, and control of open flame/sparks shall be maintained and monitored.
8. Worker will be informed about the Do’s and Don’ts to be followed during summer in the Pre Job Brief.

**Do's & Don'ts**

9. Drink plenty of cool water and other non-alcoholic fluid and keep body well hydrated.
10. Eat salt in food to replenish loss of salt through sweating.
11. Avoid over physical exercise.
12. Have adequate sleep at night.
13. Eat light and less spicy food
14. Avoid eating food which was cooked long time ago.
15. Nobody should use small water bodies such as pits, running rain water through crevices etc. for drinking and cleaning purpose as it may be unhygienic.

**Emergency Handling**

In case of emergency due to heat disorder:

16. Rescue the victim from workplace and place under shed.
17. If to be rescued from height, use stoke basket or rescue kit.
18. Inform Ambulance immediately.
19. If nearby any air conditioned room/shed is available, place him inside the room/shed.
20. Administer First aid by trained First aider for Heat Disorder
21. If conscious, give him ORS solution to drink.
22. If required send the victim hospital immediately.

**13.2.12.2 Monsoon**

**A. Height Work & Structural Safety:**

1. Ensure that all height work platforms are barricaded and avoid any highly hazardous
2. height work.
3. Ensure that all personnel have good quality and intact safety shoes
4. Stop all dangerous height work during rain
5. Explain Do's and Don'ts to workers during Tool Box Meetings
6. Ensure that there are no weak structures, boards etc. that can fall during high winds
7. Do not allow any loose material (e.g. GI sheet, Ply board, empty cement bag, aluminum foil, foam sheets etc.) on roof sheds or top of structures.
8. Do not permit any one to ride up or come down scaffolds frame work during heavy wind or rain.
9. Provide "anchor" of adequate strength to scaffolds and other high-rise structures.
10. All rest sheds and GI sheds will be anchored into the round and wall and roof panels will be secured with J hook to prevent shed from blowing over or parts/pieces becoming airborne. Proper earthing per IS standard is also to be installed.
11. Do not go alone nor permit anyone to stay at tower-tops, roof-tops, high structures or on electrical poles during the course of stormy weather or heavy rain.

## B. Electrical:

1. All electrical connections / loads have to be routed through ELCB / RCCB (residual current circuit breaker) whose rating should be 30mA.
2. RCCB operational checks need to be done DAILY / WEEKLY during monsoon season.
3. Avoid joints on power cables which need to be laid over-head or under-ground, better not to have any joint at all. In case joints become essential, such cables must be housed rigidly and insulation must be provided as per approved standard. The joint shall be suitable for outdoor use.
4. All electrical distribution board shall be properly covered at top and sides to protect from rain water. Extension boards shall be protected from rain water.
5. Ensure proper “earthing” for each and every electrical appliance.
6. Double earthing need to be provided for 3-phase power supply and for voltage more than 220V.
7. Provide lightening arrestors at the top of Boiler 3 and boiler 4 and rest sheds which are not covered by existing lightening arrestor of other installation.

## C. Others:

1. Maintain smooth flow on open drains. i.e. no obstruction or blockade shall be made on storm water drains. If required, make temporary drains.
2. Arrange back-filling of excavated pits on war-footing basis.
3. Arrange bringing down booms of all cranes, hydra machines during stormy weather (wind speed 40-50 kmph)
4. Confirm that all gantry cranes are effectively choked to prevent rolling and toppling.
5. Do not forget to deep ready a dew battery operated lights at site-offices during rainy season.
6. Avoid using wet damp clothes.
7. Barricade excavated zone filled with water.
8. Engage diesel operated water pump to dewater work area. For electrically operated water pump, the starter shall be protected from rain water. All rotating parts shall be guarded. Ensure availability of sufficient water pumps.

## D. Health and hygiene:

1. Monsoon reduces the immunity of our body and makes us vulnerable to many diseases which are commonly associated with this season. It is time for us to keep our body challenging against disease by boosting our immunity and taking safety measures against these diseases.

2. The diseases associated with monsoon are Malaria, Jaundice, Gastro-intestinal infections, like typhoid, cholera etc. apart from these viral infections like cold and cough also make their presence felt. Majority of above said diseases are on account of:
3. Puddle of water formed due to rain become breeding grounds for mosquitoes which spread disease like, malaria and dengue fever. As a precautionary measure against mosquito-bite disease one can use mosquito net around the end which is better choice to mosquito repellants like mats and coils.
4. Pollution of drinking water during monsoon is very common. It is very necessary to drink clean and pure water when water-borne monsoon diseases like diarrhea and gastro-intestinal infections threaten us.
5. Walking in dirty water during rainy season leads of numerous fungal infection which affect toes and nails. Diabetic patients have to take a special care about their feet. Keeping feet always dry and clean is very necessary. Avoid walking in dirty water. Keep shoes socks and raincoats dry and clean.

### E. Workmen will be made aware of following Do's and Don'ts:

1. Do not sleep in daytime.
2. Avoid over physical exertion.
3. During lightning and thunder storm, do not take shelter under tree. Take shelter inside rest shed or store room.
4. Wash vegetables with clean water and steam them well to kill germs.
5. Avoid eating un-cooked foods and salads should be washed properly before consumption.
6. Drink plenty of water and keep body well-hydrated.
7. Always keep the surrounding area dry and clean. Don't allow to get water accumulated around.
8. Keep body warm as viruses attack immediately when body temperature goes down.
9. Do not enter air conditioned room with wet hair and damp cloths.
10. Dry your feet and webs with soft dry cloth whenever they are wet.
11. Eat light and less spicy food.
12. Avoid eating food which was cooked long time ago.
13. Eat salt in food to replenish loss of salt through sweating.

## 13.2.12.3 Emergency Weather Conditions

### A. Cyclone/Severe thunder storm

In the event of Cyclone/Severe thunder storm, alert will be issued by subcontractor on notification received by Govt. authorities/Metrological departments Customer or BHEL.

**The actions required during cyclone/rough weather:**

1. Check and advice subcontractors to cleanup work area. Pick up all loose and unused material of respective supervisor's area.
2. Tie to secure all gas cylinders to avoid displacement and unsafe conditions which could be due to wind pressure.

3. Secure portable electricity generating sets and other equipment, pumps, hoses etc.
4. Make preparation for removal of water logging.
5. Take review of work activity and make preparation for removal of equipment and material from vulnerable areas.
6. Isolate/turn off all electrical power form the main panel/switches. Secure and anchor panels properly.
7. Recheck anchorage/tie of all temporary structures/sheds, tall objects, cranes, rigs, scaffolds etc. to avoid toppling due to wind force.
8. Cranes boom shall be secured, either locked or lowered the booms as reasonably and practicably possible and rigs to safe position for the safety point of view.
9. Group up all trash barrels, wooden pallets, forms; wooden decks etc. and anchor properly.
10. Welding machines, air compressors and such equipment are to be grouped together and secured to the stable objects. Welding leads, electrical cables, hoses are to be rolled up and secured properly.
11. Set on site vehicles on high ground in the site area with brakes set firmly.
12. Anchor all tanks, vessels, gas cylinders that may be moved by high wind and water.
13. Evacuate job site.

**Personnel Evacuation:**

14. Personnel Evacuation will be required if predicted wind speed and storm surge heights are beyond acceptable limits as per the instructions from Govt. Authorities/ Metrological departments or Customer.
15. Once the warning is received for personnel evacuation, an emergency response team shall be formed. The team will work with local authorities and other agencies formed/deployed to evacuate and transport all personnel involved in the project to the cyclone shelter.
16. Cyclone may be followed by the calm “EYE”, be aware of it. If the wind suddenly drops, don’t assume the cyclone is over. Violent wind may resume from the opposite side direction. Wait for the official “All clear Signal”.
17. After the cyclone, do not go outside until officially communicated about safe situation outside. Use recommended routes for returning. Do not panic or rush while returning.
18. Checking of gas leaks and well being of electrical appliances is essential before leaving the site.
19. Follow local communications for official warning and advice. The construction Manager shall also obtain updates from customer/metrological departments and communicate to the personnel on project site.

#### 13.2.12.4 Preparedness for Other Adverse Climates and Weather Conditions

All Preventive and Precautionary measures to ensure Health & Safety of workers in all possible adverse weather conditions based on the analysis of the local area conditions to be taken by the subcontractor

### 13.3 ENVIRONMENTAL CONTROL

1. Environment protection has always been given prime importance by BHEL. Environmental

damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life.

2. Subcontractor shall list out all applicable environmental aspects and impacts, and ensure control measures to manage the same.
3. Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used.
4. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.
5. Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per MSDS.
6. In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. Subcontractor shall use appropriate MSDS for clean-up technique. Subcontractor shall be responsible for the cleanliness of their own areas.
7. Subcontractor shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform BHEL accordingly so that reasonable & practicable precautions can be taken to protect other persons who may be affected.
8. It is imperative on the part of the subcontractor to join and effectively contribute to environmental protection measures such as tree plantation and towards social causes and maintaining good relations with local populace.
9. The subcontractor shall carry out periodic air and water quality check and illumination level checking in respective area of work place and take suitable control measure to maintain the same as per applicable laws / standards

### 13.3.1 WASTE MANAGEMENT

1. Subcontractor shall take suitable measures for waste management and fulfilling requirements of environment related laws/legislation as a part of normal construction activities.
2. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.
3. Details of E-Waste, Hazardous Waste, shall be submitted to BHEL as per Format No. HSEP: 14-F18 and HSEP: 14-F19 respectively

#### 13.3.1.1 BINS AT WORK PLACE

1. Sufficient rubbish bins shall be provided close to workplaces.
2. Bins should be painted yellow and numbered.
3. Sufficient nos. of drip trays shall be provided to collect oil and grease.
4. Sufficient qty. of broomsticks with handle shall be provided.
5. Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

#### 13.3.1.2 STORAGE AND COLLECTION

1. Different types of rubbish/waste should be collected and stored separately.

2. Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
3. Rubbish should not be left or allowed to accumulate on construction and other work places.
4. Do not burn construction rubbish near working site.

#### 13.3.1.3 SEGREGATION

1. Earmark the scrap area for different types of waste.
2. Store wastes away from building.
3. Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
4. Clinical and first aid waste stored and incinerated separately.

#### 13.3.1.4 DISPOSAL

1. Sufficient containers and scrap disposal area should be allocated.
2. All scrap bin and containers should be conveniently located.
3. Provide self-closing containers for flammable/spontaneously combustible material.
4. Keep drainage channels free from choking.
5. Make schedule for collection and disposal of waste.

#### 13.3.1.5 WARNING AND SIGNS

1. Appropriate signage to be displayed at scrap storage area
2. No toxic, corrosive or flammable substance to be discarded into public sewage system.
3. Waste disposal shall be in accordance with best practice.
4. Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

### 13.4 HOUSEKEEPING

1. Keeping the work area clean/ free from debris, removing unused scaffoldings, scraps, insulation/ sheeting wastage /cut pieces temporary structures, packing woods etc. will be in the scope of the subcontractor.
2. Such cleaning has to be done by subcontractor within quoted rate, on daily basis by dedicated identified groups equipped with all require PPEs and training. The details of housekeeping group shall be provided to BHEL.
3. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from subcontractor's bill. Such decisions of BHEL shall be binding on the subcontractor.
4. Pests, such as beehives etc. shall be periodically removed in a humane fashion
5. **Following are to be taken care of on daily basis.**

i. All surplus earth and debris are removed/disposed of from the working areas to identified locations.
ii. Unused/Surplus cables, steel items and steel scrap lying scattered at different places /elevation within the working areas are removed to identify locations.
iii. All wooden scrap, empty wooden cable drums and other combustible packing materials, shall

be removed from workplace to identified locations. Sufficient waste bins shall be provided at different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high locations

iv. Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
v. Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
vi. Labor camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
vii. Fabricated steel structures, pipes & piping materials shall be stacked properly.
viii. No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.
ix. Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas

## 13.5 TRAFFIC MANAGEMENT

### 13.5.1 SAFE WORKPLACE TRANSPORT SYSTEM

1. Traffic routes in a work place shall be suitable for the persons or vehicles using them.
2. Traffic routes for pedestrians and vehicles shall be clearly demarcated and indicated
3. Traffic routes shall never intersect the area of work and shall not endanger the site personnel
4. For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
5. Temporary obstacles shall be brought to the attention of drivers by warning signs / hazard cones.
6. Power cables shall be maintained at a minimum height above ground as specified in Indian Electricity Act & Rules.
7. Sensible speed limits shall set and clearly displayed. Painted Speed ramps preceded by a warning signs or marker are necessary for stretches of roads exceeding 50 meters.
8. The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
9. Safest route shall be provided between places where vehicles have to call or deliver.
10. Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse
11. Safe areas shall be provided for loading and unloading of material. Loading / Unloading Permit shall be taken from BHEL prior to any significant loading / unloading activity
12. Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
13. Ensure road crossings are minimum and clearly signed.
14. Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
15. Forklift trucks shall not pass over road hump unless of a type capable of doing so.

16. Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
17. The height of Power cables above areas of movement shall conform to Indian Electricity Rules
18. Road traffic signs shall be provided on prominent locations for prevention of accidents and hazards and for quick guidance and warning to employees and public.
19. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done.
20. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

### 13.5.2 TRAFFIC ROUTE FOR PEDESTRIANS

1. Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
2. Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
3. Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
4. Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
5. Provide high visibility clothing for people permitted in delivery area.

### 13.5.3 WORK VEHICLES

Work vehicles shall be as safe stable efficient and roadworthy as private vehicles on public roads. Subcontractors shall ensure that drivers are suitably trained and have valid license and experience for the designated class of vehicle. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

1. A high level of stability.
2. A safe means of access/egress.
3. Suitable and effective service and parking brakes.
4. Windscreens with wipers and external mirrors giving optimum all round visibility.
5. Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
6. Provision of seat belts.
7. Guards on dangerous parts.
8. Driver protection - to prevent injury from overturning and from falling objects/materials.
9. Driver protection from adverse weather.
10. No vehicle shall be parked below HT/LT power lines in conformance to Indian Electricity Act & Rules.
11. Valid Pollution Under Control certification for all vehicles

### 13.5.4 DAILY CHECKS BY DRIVER

There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used. Subcontractors should ensure that drivers carry out these checks as a minimum.

| | | |
|---|---|---|
| Brakes | Mirrors | Warning signals |
| Tires | Windscreen waters | Specific safety system i.e. control interlocks |
| Steering | Wipers | |

### 13.5.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

1. All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
2. Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
3. All overhangs shall be made clearly visible and restricted to acceptable limits
4. Load shall be checked before moving off and after traveling a suitable distance.
5. On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.
6. Warning signs shall be displayed during transportation of material.
7. All vehicles used by Subcontractor shall be in worthy condition and in conformance to the Land Transport requirement

### 13.5.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

## 13.6 EMERGENCY PREPAREDNESS AND RESPONSE

1. Subcontractor shall develop Emergency preparedness and response capability and Emergency Response Team as per HSEP06: HSE Procedure for Emergency Preparedness and Response
2. Availability of adequate number of first aiders and fire warden shall be ensured
3. All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures and communicate the same to BHEL.
4. Assembly point shall be earmarked and access to the same from different location shall be shown
5. Fire exit shall be identified and pathway shall be clear for emergency escape.
6. Appropriate type and number of fire extinguisher shall be deployed as per Clause No. 13.2.11 and validity shall be ensured periodically through inspection
7. Adequate number of first aid boxes shall be strategically placed at different work places to cater

to all emergency needs. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.

8. First aid center shall be developed at site with trained medical personnel and ambulance
9. Emergency contact numbers of the site shall be displayed at prominent locations.
10. Tie up with fire brigade shall be done in case customer is not having fire station.
11. Tie up with hospital shall be ensured in order to ensure the availability of following services to victims quickly without wasting precious time:
    a. Intensive Care Unit with Ventilator and other necessary life support systems
    b. Facility of specialized Orthopedic Surgery – in case of fracture / amputation
    c. Facility of specialized brain / neuro surgery – in case of head trauma
    d. Facility of specialized burn unit / ward – in case of Fire / burn injury
    e. and other facilities as per requirement at site location

    In case tie up with multiple hospitals is required to cover all possible accidents, same shall be done. The list of facilities to be regularly checked and updated.
12. A detailed emergency services (Fire / Medical etc.) tie up plan shall be submitted to BHEL in monthly report Format No. HSEP:14-F05
13. Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

## *14 HSE INSPECTION*

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSEMS requirements. The subcontractor shall maintain necessary safety equipment as applicable, to enable inspection personnel/agency perform Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

The requirements of respective work permits are to be ensured by respective supervisors, safety personnel and area in-charges. In addition, the formats & checklists as per Clause 21 of this document provided by BHEL shall be used for inspection by Safety personnel (as a minimum), and records of inspection to be maintained. BHEL shall reserve the right to modify any Format in this document or introduce additional checklists / formats to ensure regular inspection of all equipment as per requirement.

### 14.1 DAILY HSE CHECKS

Both the Site Supervisors and HSE Supervisors are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

1. **Height Work:**
   a. Safe, barricaded platform
   b. PPEs
   c. Proper method
   d. Awareness
2. Personal Safety wears & gear compliance.
3. Complying with site safety rules and permit-to-work (PTW).
4. Positions and postures of workers.
5. Use of tools and equipment etc. by the workers.
6. The inspection shall be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

### 14.2 INSPECTION OF HEIGHT WORKING

1. Any kind of height work (above 2 meters) shall not be carried out without active physical supervision by concerned supervisor or safety personnel. All non-conformances related to height work shall be handled on priority and closed immediately after halting the work.
2. A roster of personnel deployed for inspection of height work and other critical activities shall be prepared and submitted to BHEL in monthly report Format No. HSEP:14-F05, in order to ensure effective supervision at all times
3. Inspection on height working shall be conducted **daily** by supervisors before start of work to ensure safe working condition including provision of:

| | | |
|---|---|---|
| a. Fall arrestor<br>b. Lifelines<br>c. Safety nets | d. Fencing and barricading<br>e. Warning signage<br>f. Covering of opening | g. Proper scaffolding with valid Tags, access and egress.<br>h. Illumination |

4. Inspection on height working shall be conducted once in a week by HSE officer as per
5. Format no. HSEP: 14-F10.
6. Medical fitness, including vertigo test of height worker shall be ensured.
7. Height working shall not be allowed during adverse weather.

### 14.3 INSPECTION OF PPE

PPEs shall be inspected by HSE officer at random once in a week as per Format no. HSEP: 14-F06 for compliance to standard and provisions and any adverse observation shall be recorded in the PPE register.

### 14.4 INSPECTION OF T&Ps

1. All T& Ps being used at site shall be inspected by HSE officer once in a month as per specific Formats in this document, or (if not available) general Format no. HSEP: 14-F07 for its healthiness and maintenance.
2. A master list of T&Ps and validity of their inspection certificates shall be maintained by each agency and details shall be submitted to BHEL in monthly format no. HSEP:14-F05.
3. The T&Ps which require third party inspection shall be checked for its validity during inspection.

The third party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record. BHEL shall be given advance intimation of Third Party Inspection. BHEL shall associate with Inspection as per discretion.

### 14.5 INSPECTION OF CRANES AND WINCHES

1. Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
2. Cranes and Winches shall be inspected by HSE officer once in a month as per Format no. HSEP: 14-F08 & F09 for healthiness, maintenance and validity of third party inspection.
3. The date of third party inspection and next due date shall be painted on cranes and winches.
4. The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
5. The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

### 14.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

1. Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
2. Gas cylinders shall be kept upright.
3. Use of Flash back arrestor shall be ensured at both ends.
4. Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per Format no. HSEP: 14-F11.
5. Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
6. Availability of fire extinguisher in vicinity shall be ensured.

### 14.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

1. Ensure proper earthing in electrical installation
2. Use of ELCB at electrical booth
3. Electrical installation shall be properly covered at top where required
4. Use appropriate PPEs while working
5. Use portable electrical light < 24 V in confined space and potentially wet area.
6. Monthly inspection shall be carried out as per Format no. HSEP: 14-F12.

### 14.8 INSPECTION OF ELEVATOR

1. Elevators shall be inspected by concerned supervisors once in a week as per Format no. HSEP: 14-F13.
2. All elevators shall be inspected by competent person and validity shall be ensured.
3. The date of third party inspection and next due date shall be painted on elevator.

### 14.9 MONTHLY SITE INSPECTION

Subcontractor shall carry out monthly HSE inspection of all work areas as per Format No. HSEP:14-F20 and submit to BHEL

### 14.10 NON-CONFORMITY HANDLING:

Any serious non-conformances identified during inspection observed shall be addressed immediately.

In case immediate closure of non-conformities is not possible:

a. work to be halted in the area
b. Non-conformance to be generated and submitted to responsible person and BHEL
c. non-conformance to be resolved through responsible agency / person
   Only after closure of serious non-conformances, work to be allowed to resume.

All non-conformances & safety violations to be recorded and closed in a time bound manner.

## *15 HSE PERFORMANCE*

HSE performance of subcontractor shall be monitored as per BHEL criteria, based on which, marks will be awarded. Marks can be used to evaluate and rate the contractor as per BHEL internal systems

HSE performance of the subcontractor shall be monitored as per the following parameters: (For each contract-wise package). **Periodicity**: RA Bill period

| Sl. No. | Parameters of measurement | Ref Clauses | Weightage | Actual |
|---|---|---|---|---|
| 1 | Availability of safety officers at site – absence up to 15% permissible. Score proportionately gets reduced with higher rate of absence. Availability to be reckoned from start date of manpower mobilization | 7.1 | 10 | |
| 2 | Attendance by the safety officer and site CM (as applicable) in the meeting convened by BHEL | 20 | 5 | |
| 3 | Level of compliance w.r.t decisions taken in previous meetings/audit/inspection/as reported. | -do- | 5 | |
| 4 | Timely submission of monthly report on safety in the prescribed format | 11 | 3 | |
| 5 | Timely reporting any incident including near–miss to BHEL /Customer/statutory authority (if required) and submission of investigation report of all LTIs/ | 12 | 10 | |

| | | | | |
|---|---|---|---|---|
| | Major Property Loss incident and HSE events | | | |
| 6 | Degree of PPE compliance, Fall protection arrangements and safety net coverage | 8.3, 14 | 15 | |
| 7 | Level of compliance w.r.t safety rules | 13,14 | 25 | |
| 8 | Availability of proper first-aid facility , ambulance, hygienic labor colony and other adequate labor welfare initiatives, conducting of health check-up as per BOCW requirements | 8 | 6 | |
| 9 | Conducting induction training, skill training, tool box meeting, mock-drills, HSE Promotion, Emergency Preparedness and Response. Participation in BHEL training also counted | 9.0 | 6 | |
| 10 | Level of House-keeping, Environmental Control | 13.3, 13.5 | 10 | |
| 11 | Level of general illumination | 8.4.11 | 5 | |
| **A** | **TOTAL Obtained** | | 100 | |

Penalty score:

i. For each fatality: -10
ii. For each Major Incident: -07

NET TOTAL score will be arrived after deducting penalty score from Total score.

Subcontractor shall make available all data required for evaluation to BHEL as and when demanded.

1. If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job.

2. 1.5% of running bill shall be cleared subject to certification of desired safety performance by BHEL

## *16 HSE PENALTIES FOR NON-COMPLIANCE*

1. Nonconformity of safety rules and safety appliances will be viewed seriously and BHEL has right to impose fines on the subcontractor for every instance of violation noticed.

2. The applicable penalties for HSE violations are given in Format No. HSEP14-F14 of this document

3. The list of non-compliances given in above format is not exhaustive. The BHEL site in-charge has liberty to impose a penalty for any other non-compliance and incidents of any nature.

4. If principal customer or statutory and regulatory bodies impose penalty on ground of statutory non-compliance or non-compliance of HSE rules by the subcontractor or any incident of any nature including fatality or permanent disability, the same shall be passed on to the subcontractor with appropriate overhead

5. The penalty amount shall be recovered from subcontractors from the RA Bill, otherwise Final bill.

## *17 COMPENSATION TO ACCIDENT VICTIMS*

1. BHEL shall recover the amount of compensation paid to victim(s) by BHEL towards loss of life / permanent disability due to an accident which is attributable to the negligence of contractor, agency or firm or any of its employees as detailed below.

b. **Victim**: Any person who suffers permanent disablement or dies in an accident as defined below.

c. **Accident:** Any death or permanent disability resulting solely and directly from any unintended and unforeseen injurious occurrence caused during the manufacturing/ operation and works incidental thereto at BHEL factories/ offices and precincts thereof, project execution, erection and commissioning, services, repairs and maintenance, trouble shooting, serving, overhaul, renovation and retrofitting, trial operation, performance guarantee testing undertaken by the company or during any works / during working at BHEL Units/ Offices/ townships and premises! Project Sites.

**d. Compensation in respect of each of the victims:**

i. In the event of death or permanent disability resulting from Loss of both limbs: Rs. 10,00,000/- (Rs. Ten Lakh)

ii. (ii) In the event of other permanent disability: Rs. 7,00,0001- (Rs. Seven Lakh)

e. **Permanent Disability**: A disablement that is classified as a permanent total disablement under the proviso to Section 2 (I) of the Employee's Compensation Act, 1923. "

2. In addition to above, contractor shall provide appropriate compensation to victims of major and fatal incidents as per Employee Compensation Act, 1923, ESIC Act, 1948 or as per any existing Acts and guidelines

## *18 INTERNAL & EXTERNAL HSE AUDITS*

1. Subcontractor shall extend full co-operation and maintain necessary documents & records as required by Internal & External HSE Audit carried out by BHEL. / Third Party
2. All non-conformities and observations on HSE shall be disposed of-by subcontractor in a time bound manner as detailed in Audit Report.
3. All required corrective actions shall be taken by the subcontractor in order to avoid recurrence

## *19 OTHER REQUIREMENTS*

1. In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after holding an appropriate enquiry and notifying the subcontractor suitably.

2. **RISK & COST:**

   If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety as per contractual requirements, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.

3. If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favourably consider to reward the subcontractor suitably for the performance.

4. The subcontractor shall take all measures at all the sites of work to protect all persons from incidents and shall be bound to bear the expenses of every suit, action or other proceeding of law that may be brought by any persons for injury sustained, death or damage to environment

owing to neglect of the HSE precautions by the subcontractor; and shall be liable to pay any such persons such compensation, should such claim proceeding be filed against BHEL.

The subcontractor hereby agrees to indemnify BHEL against the same.

## *20 HSE REVIEW*

BHEL shall hold HSE review meeting every month or as per requirement in order to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting, its root cause and Corrective action. The indicative agenda is given below:

1. Implementation of earlier MOM
2. HSE performance review
3. HSE inspection review w.r.t non-conformances observed and their status
4. HSE audit and CAPA
5. HSE training conducted and requirement
6. Health check-up camp
7. HSE planning for the erection and commissioning and installation activities in the coming month
8. HSE reward and promotional activities
9. HSE data analysis and improvement – Data analyzed will include non-conformances closed and pending, incident data, training data etc.

Subcontractor shall ensure presence of site in-charge, all package in-charges and safety officers, as communicated by BHEL in the meeting.
Subcontractor shall take requisite actions as per record notes and as decided in the meeting, in a time bound manner and submit compliance report to BHEL.

## 21 FORMATS USED

This is minimum list of Formats to be used for reporting by the subcontractor. Other Formats are indicated in respective HSE Procedures, Work Permits, OCPs or as specified by BHEL. The medium of reporting can be hard / soft as indicated by BHEL.
BHEL can modify these Formats or introduce new Formats to the extent necessary to get the desired performance data of all HSE activities.

| SN | Format Name | Format No. | Frequency of check | Rev |
|---|---|---|---|---|
| 1 | Work at Height Permit | HSEP:14-FP01 | Before start of work and regularly thereafter as per Permit conditions | 00 |
| 2 | Hot Work Permit | HSEP:14-FP02 | | 00 |
| 3 | Confined Space Work Permit | HSEP:14-FP03 | | 00 |
| 4 | Excavation Work Permit | HSEP:14-FP04 | | 00 |
| 5 | Radiation Work Permit | HSEP:14-FP05 | | 00 |
| 6 | Lifting Activity Work Permit | HSEP:14-FP06 | | 00 |
| 7 | Lockout-Tagout Work Permit | HSEP:14-FP07 | | 00 |
| 8 | Inspection of First Aid Box | HSEP:14-F01 | Weekly | 00 |
| 9 | Health Check Up | HSEP:14-F02 | With new Induction & as per requirement thereafter | 00 |
| 10 | HSE Induction / Regular / On-the-Job Training | HSEP:14-F03 | With new Induction & as per requirement thereafter | 00 |
| 11 | Tool Box Talk | HSEP:14-F04 | Daily before job start | 00 |
| 12 | Site HSE Report | HSEP:14-F05 | Monthly | 00 |
| 13 | PPE Inspection | HSEP:14-F06 | Weekly | 00 |
| 14 | PPE Issue and Receipt | HSEP:14-F06A | With new Induction | |
| 15 | Inspection of T&Ps (General) | HSEP:14-F07 | Monthly / As per requirement | 00 |
| 16 | Inspection of Cranes | HSEP:14-F08 | Monthly / As per requirement | 00 |
| 17 | Inspection of Winches | HSEP:14-F09 | Monthly / As per requirement | 00 |
| 18 | Inspection of Height Working | HSEP:14-F10 | Daily / As per requirement | 00 |
| 19 | Inspection on Welding & Gas Cutting | HSEP:14-F11 | Weekly / As per requirement | 00 |
| 20 | Inspection on Electrical Installation | HSEP:14-F12 | Weekly / As per requirement | 00 |
| 21 | Inspection on Elevator | HSEP:14-F13 | Weekly / As per requirement | 00 |
| 22 | HSE Penalty | HSEP:14-F14 | - | 00 |
| 23 | Initial Verification of PPE's & Lifting Tools & Tackles | HSEP:14-F15 | As and when new PPEs and T&Ps are received | 00 |
| 24 | Inspection of Labor Colony | HSEP:14-F16 | Monthly / as per requirement | 00 |
| 25 | Recording of First Aid Injuries | HSEP:14-F17 | As and when such injuries occur | 00 |
| 26 | E-waste Handled / Generated | HSEP:14-F18 | Half Yearly | 00 |
| 27 | Hazardous Waste at the Facility | HSEP:14-F19 | Half Yearly | 00 |
| 28 | HSE Checklist-cum-Compliance Report | HSEP:14-F20 | As per Audit Calendar | 00 |
| 29 | Illumination Levels | HSEP:14-F21 | Weekly / As per requirement | 00 |
| 30 | Incident Reporting | HSEP:14-F22 | - | 00 |
| 31 | Incident Recording | HSEP:14-F23 | - | 00 |

HSEP:14-FP01

| WORK AT HEIGHT PERMIT | Permit No. & Date |
|---|---|
| Project & Unit: | Emergency Contact Nos: |
| BHEL Sub-contractor: | |

Exact Location of Work:_____

Nature / Description of Work:_____

Duration of Work Execution *: From Date:_____to Date:_____Daily from _____ hrs. to _____hrs.

Name of Sub-Contractor Performing the Work: _____

Name of Sub-Contractor's Site Engineer (Permit Requesting Authority):_____Sign:_____

Name of Sub-Contractor's Package In-charge:_____Sign:_____Date:_____

*The above described work will be done under all the safety precautions mentioned as under during the currency of the Permit.*

| No. | Item | Yes | Not required / Remarks |
|---|---|---|---|
| 1 | All workers on job are competent and medically fit (No Height Phobia) for working at height | | |
| 2 | Hazards in the vicinity are identified, controlled and communicated to the worker. | | |
| 3 | Scaffolding soundness inspected is available for use with valid tag | | |
| 4 | Work platform is not made of bamboo or weak material. Barricading is available with Top, Mid Rails and Toe Guard. | | |
| 5 | Working platform is clean without any unwanted material. Floor openings are covered. | | |
| 6 | Access and exit to workplace are safe, marked and without obstruction. | | |
| 7 | Adequate lighting provided (for dark hours) as per applicable lux standards (Refer HSEP:13) | | |
| 8 | Safety nets are provided below working area. | | |
| 9 | Area below the working platform has been cleared of all activity | | |
| 10 | Ladders have been secured, inspected and provided as per BHEL standard/contract. | | |
| 11 | Horizontal life lines are provided to cater to design specification of 2300 kg per person. | | |
| 12 | Safety harness with life line support/ fall arrester are checked and available in working condition | | |
| 13 | Safety shoes (non-slip), Helmet with chin strip available with employees | | |
| 14 | Visible Signboards provided on working platforms in workers' understandable language | | |
| 15 | All lifting / tightening tools, hand tools/equipment checked and in good condition | | |
| 16 | ELCB provided for Electrical connections individually. Electrical cable, welding Hose/Compressed air hose properly secured and laid down without obstruction. Earth resistance is OK. | | |
| 17 | Crane / Winch / Hydra operator is qualified and experienced | | |
| 18 | Emergency response team & Medical Facilities available. Work area is cordoned off. | | |
| 19 | Job Safety Analysis Submitted | | |
| 20 | Additional Permits to be taken (Please specify & attach): | | |

**Declaration:** ***All the points mentioned in the above checklist have been checked and found OK***

**Permit Receiver:**

| Site Engineer (Sub- Contractor): | | Site Safety Officer (Sub-Contractor): | |
|---|---|---|---|
| Signature: | | Signature: | |
| Name: | Designation: | Name: | Designation: |

**Permit Issuer:**

| Engineer of Concerned Execution Department (BHEL): | | Site Safety Officer (BHEL): | |
|---|---|---|---|
| Signature: | | Signature: | |
| Name: | Designation: | Name: | Designation: |

| Package-in-charge (BHEL): | |
|---|---|
| Signature: | |
| Name: | Designation: |

***Verified by Customer Representative (if applicable), Name:*** _____***Sign:*** _____***Date:*** _____***Time:*** _____

**(* Permit valid for 7 days, subject to daily renewal, and extension as per overleaf instructions / record formats)**

Work at Height Permit No. & Date: _____

**Daily Work Area Condition Endorsement**

| Sl. No. | Date | Signature with Date & Time | | Remarks |
|---|---|---|---|---|
| | | Agency Safety | BHEL Safety | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |

**Permit Extension Beyond Initially Requested Hours**

| Sl. No. | Extension Period | | Remarks | Signature with Date & Time | | | |
|---|---|---|---|---|---|---|---|
| | From……. (Date & Time) | To…… (Date &Time) | | Agency Site Engineer | Agency Safety Officer | BHEL Site Engineer (PIA) | BHEL Safety Officer |
| **1.** | | | | | | | |
| **2.** | | | | | | | |
| **3.** | | | | | | | |
| **4.** | | | | | | | |
| **5.** | | | | | | | |
| **6** | | | | | | | |

| **TO BE SIGNED BY THE BHEL HSE & EXECUTION AFTER THE WORK IS OVER** | |
|---|---|
| **Permit is here by returned after completing the job & ensuring safe removal of men and material.** | |
| **Site Engineer, BHEL** | **Site HSE Engineer, BHEL** |
| Signature: | Signature: |
| Name: | Name: |

***General Instructions:***

| | |
|---|---|
| 1 | This Permit is required for working at height of 2 mtr. and above or above excavation of 2 mtr or deeper. |
| 2 | This permit must be available at the work site all the times of the work. |
| 3 | Location and description of the work must be clearly indicated by the permittee. |
| 4 | Terms applicable must be clearly indicated by the permittee. |
| 5 | This permit shall be endorsed each day only after checking all the compliance jointly by the contractor and BHEL safety. |
| 6 | Permit shall be issued for not more than **7 days** including the issue date. |
| 7 | Permit shall be returned to the HSE Department of BHEL after completion of the job. |
| 8 | Before engaging anybody to work at height, height phobia needs to be ascertained and proper fitness certificate to be ensured. |
| 9 | All safety precautions to be taken as per work site HSE plan. |
| **10** | **Distribution of copy:** |
| | Original- Permittee, Duplicate –Department HOS, Contractor, Triplicate - Site HSE Dept., |



**To be printed on both sides of an A4 Sheet**

HSEP:14-FP02

| HOT WORK PERMIT | Permit No. & Date |
|---|---|
| Project & Unit: | Emergency Contact Nos: |
| BHEL Sub-contractor: | |

Exact Location of Work:_____

Nature / Description of Work: _____

Duration of Work Execution *: From Date:_____to Date:_____Daily from _____ hrs. to _____hrs.

Name of Sub-Contractor Performing the Work: _____

Name of Sub-Contractor's Site Engineer (Permit Requesting Authority):_____Sign:_____

Name of Sub-Contractor's Package In-charge:_____Sign:_____Date:_____

*The above described work will be done under all the safety precautions mentioned as under during the currency of the Permit*.

| No. | Item | Yes | Not required / Remarks |
|---|---|---|---|
| 1. | Welder is trained and qualified with good attendance in on-the-job training | | |
| 2. | Area ensured safe and free from all hazards (explosives etc.) with barricading and safe inlet / exit | | |
| 3. | Proper ventilation and lighting provided (in case of dark hours). | | |
| 4. | Gas hoses are in good condition and not cut / leaking | | |
| 5. | Pressure gauges/Flash back arrestor (at both ends) provided and in working condition. | | |
| 6. | Gas pressure in cylinder is within limits and hydraulic test certificate is available | | |
| 7. | Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder. Gas cylinders covered with shields to prevent falling splinters. | | |
| 8. | Power supply to welding machine is through ELCB of 30 mA rating, which is tested and found ok; Earthing is tested and found OK | | |
| 9. | Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition. | | |
| 10. | In case of welding in enclosed / confined spaces, the integrity of the structure and supports are ensured, Gas Testing done and evacuation system ensured in place | | |
| 11. | Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it. | | |
| 12. | Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine. | | |
| 13. | Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety (rubber) shoes, leather gloves, long sleeve and nose mask -provided | | |
| 14. | In case of pits, water removed from the pit and wood/rubber insulation provided. | | |
| 15. | Safety signboards / cautions are in place. | | |
| 16. | Adequate and Suitable nos. of applicable firefighting extinguisher provided. | | |
| 17. | Nearby combustible material removed. Housekeeping done. | | |
| 18. | All workers explained about the hazards | | |
| 19. | First aid in attendance. | | |
| 20. | Any other Precautions or Permits required (Height Work, Confined Space etc.), give details and attach | | |

**Declaration:** ***All the points mentioned in the above checklist have been checked and found OK***

**Permit Receiver:**

| Site Engineer (Sub- Contractor): | | Site Safety Officer (Sub-Contractor): | |
|---|---|---|---|
| Signature: | | Signature: | |
| Name: | Designation: | Name: | Designation: |

**Permit Issuer:**

| Engineer of Concerned Execution Department (BHEL): | | Site Safety Officer (BHEL): | |
|---|---|---|---|
| Signature: | | Signature: | |
| Name: | Designation: | Name: | Designation: |

| Package-in-charge (BHEL): | |
|---|---|
| Signature: | |
| Name: | Designation: |

***Verified by Customer Representative (if applicable), Name:*** _____***Sign:*** _____***Date:*** _____***Time:*** _____

**(* Permit valid for 7 days, subject to daily renewal, and extension as per overleaf instructions / record formats)**

Hot Work Permit No. & Date: _____

## Daily Work Area Condition Endorsement

| Sl. No. | Date | Signature with Date & Time | | Remarks |
|---|---|---|---|---|
| | | Agency Safety | BHEL Safety | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |

## Permit Extension Beyond Initially Requested Hours

| Sl. No. | Extension Period | | Remarks | Signature with Date & Time | | | |
|---|---|---|---|---|---|---|---|
| | From……. (Date & Time) | To…… (Date &Time) | | Agency Site Engineer | Agency Safety Officer | BHEL Site Engineer (PIA) | BHEL Safety Officer |
| **1.** | | | | | | | |
| **2.** | | | | | | | |
| **3.** | | | | | | | |
| **4.** | | | | | | | |
| **5.** | | | | | | | |
| **6** | | | | | | | |

| **TO BE SIGNED BY THE BHEL HSE & EXECUTION AFTER THE WORK IS OVER** | |
|---|---|
| **Permit is here by returned after completing the job & ensuring safe removal of men and material.** | |
| **Site Engineer, BHEL** | **Site HSE Engineer, BHEL** |
| Signature: | Signature: |
| Name: | Name: |

***General Instructions:***

| | |
|---|---|
| 1 | This Permit is required for all kinds of Hot Work eg. Welding, cutting etc.. |
| 2 | This permit must be available at the work site all the times of the work. |
| 3 | Location and description of the work must be clearly indicated by the permittee. |
| 4 | Terms applicable must be clearly indicated by the permittee. |
| 5 | This permit shall be endorsed each day only after checking all the compliance jointly by the contractor and BHEL safety. |
| 6 | Permit shall be issued for not more than **7 days** including the issue date. |
| 7 | Permit shall be returned to the HSE Department of BHEL after completion of the job. |
| 8 | Before engaging anybody to work, competency and fitness to be ensured. |
| 9 | All safety precautions to be taken as per work site HSE plan. |
| **10** | **Distribution of copy:** |
| | Original- Permittee, Duplicate –Department HOS, Contractor, Triplicate - Site HSE Dept., |

HSEP:14-FP03

| CONFINED SPACE WORK PERMIT | Permit No. & Date |
|---|---|
| **Project & Unit:** | **Emergency Contact Nos:** |
| **BHEL Sub-contractor:** | |

Exact Location of Work:_____

Nature / Description of Work:_____

Duration of Work Execution *: From Date:_____to Date:_____Daily from _____ hrs. to _____hrs.

Name of Sub-Contractor Performing the Work: _____

Name of Sub-Contractor's Site Engineer (Permit Requesting Authority):_____Sign:_____

Name of Sub-Contractor's Package In-charge:_____Sign:_____Date:_____

*The above described work will be done under all the safety precautions mentioned as under during the currency of the Permit.*

| No. | Item | Yes | Not required / Remarks |
|---|---|---|---|
| 1. | Has the equipment been Isolated from Power/Steam/Air? | | |
| 2. | Has the equipment been Isolated from liquid or gases? | | |
| 3. | Has the equipment been de-pressurized &/or drained? | | |
| 4. | Has the equipment been Blanked/blinded or disconnected? | | |
| 5. | Has the equipment been water flushed &/or steamed? | | |
| 6. | Whether man ways open and ventilated? | | |
| 7. | Whether constant Inert gas flow arranged? | | |
| 8. | Whether mechanically ventilated and adequately cooled? | | |
| 9. | Whether 24 V lighting provided inside the confined space? | | |
| 10. | Whether Radiation sources removed? | | |
| 11. | Whether training on confined space provided to the individual / group? | | |
| 12. | Whether required PPEs (hand gloves, goggles, face shield, ear plug/muff, protective clothing etc.) used? | | |
| 13. | Whether Safety harness and Lifeline used? | | |
| 14. | Whether Dust/Gas/Air Line mask used? | | |
| 15. | Whether attendant with SCBA/Air mask available? | | |
| 16. | Whether grounded air Exhaust/Blower/ AC provided? | | |
| 17. | Whether Personal Gas alarm provided? | | |
| 18. | Whether communication Equipment Provided? | | |
| 19. | Whether rescue equipment/team available? | | |
| 20. | Whether firefighting arrangement done | | |
| 21. | Any other Precautions or Permits required (Height Work, Confined Space etc.), give details and attach | | |

**Declaration:** ***All the points mentioned in the above checklist have been checked and found OK***

**Permit Receiver:**

| **Site Engineer (Sub- Contractor):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

| **Site Safety Officer (Sub-Contractor):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

**Permit Issuer:**

| **Engineer of Concerned Execution Department (BHEL):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

| **Site Safety Officer (BHEL):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

| **Package-in-charge (BHEL):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

***Verified by Customer Representative (if applicable), Name:*** _____***Sign:*** _____***Date:*** _____***Time:*** _____

**(* Permit valid for 7 days, subject to daily renewal, and extension as per overleaf instructions / record formats)**

Confined Space Work Permit No. & Date: _____

**Daily Work Area Condition Endorsement**

| Sl. No. | Date | Signature with Date & Time | | Remarks |
|---|---|---|---|---|
| | | Agency Safety | BHEL Safety | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |

**Permit Extension Beyond Initially Requested Hours**

| Sl. No. | Extension Period | | Remarks | Signature with Date & Time | | | |
|---|---|---|---|---|---|---|---|
| | From……. (Date & Time) | To…… (Date &Time) | | Agency Site Engineer | Agency Safety Officer | BHEL Site Engineer (PIA) | BHEL Safety Officer |
| **1.** | | | | | | | |
| **2.** | | | | | | | |
| **3.** | | | | | | | |
| **4.** | | | | | | | |
| **5.** | | | | | | | |
| **6** | | | | | | | |

| **TO BE SIGNED BY THE BHEL HSE & EXECUTION AFTER THE WORK IS OVER** | |
|---|---|
| **Permit is here by returned after completing the job & ensuring safe removal of men and material.** | |
| **Site Engineer, BHEL** | **Site HSE Engineer, BHEL** |
| Signature: | Signature: |
| Name: | Name: |

***General Instructions:***

| | |
|---|---|
| 1 | This Permit is required for all confined space tasks, where injury can happen due to lack of oxygen, or chances of fire are there due to gas accumulation. |
| 2 | This permit must be available at the work site all the times of the work. |
| 3 | Location and description of the work must be clearly indicated by the permittee. |
| 4 | Terms applicable must be clearly indicated by the permittee. |
| 5 | This permit shall be endorsed each day after checking all the compliance jointly by the contractor and BHEL safety. |
| 6 | Permit shall be issued for not more than **7 days** including the issue date. |
| 7 | Permit shall be returned to the HSE Department of BHEL after completion of the job. |
| 8 | Before engaging anybody to work, competency and fitness to be ensured. |
| 9 | All safety precautions to be taken as per work site HSE plan. |
| **10** | **Distribution of copy:** |
| | Original- Permittee, Duplicate –Department HOS, Contractor, Triplicate - Site HSE Dept., |

HSEP:14-FP04

| EXCAVATION WORK PERMIT | Permit No. & Date |
|---|---|
| **Project & Unit:** | **Emergency Contact Nos:** |
| **BHEL Sub-contractor:** | |

Exact Location of Work:_____

Nature / Description of Work:_____

Duration of Work Execution *: From Date:_____to Date:_____Daily from _____ hrs. to _____hrs.

Name of Sub-Contractor Performing the Work: _____

Name of Sub-Contractor's Site Engineer (Permit Requesting Authority):_____Sign:_____

Name of Sub-Contractor's Package In-charge:_____Sign:_____Date:_____

*The above described work will be done under all the safety precautions mentioned as under during the currency of the Permit.*

| No. | Item | Yes | Not required / Remarks |
|---|---|---|---|
| 1 | Precautions taken for Underground Electrical Cable | | |
| 2 | Precautions taken for Under / Above ground sewer/Drinking Water Line | | |
| 3 | Precautions taken for Underground Telecommunication Line | | |
| 4 | Precautions taken for Underground Product/Utility Line | | |
| 5 | Precautions taken for Underground Fire Water Line | | |
| 6 | Shoring / Shuttering / Sheet piling done to prevent collapse of excavation walls. Strength of Excavation wall ensured at all times | | |
| 7 | Hard Barricading & Edge Protection provided | | |
| 8 | Separate Safe Access for Man and Vehicle | | |
| 9 | Lighting arrangement | | |
| 10 | Banks Man Provided | | |
| 11 | Required basic PPEs provided | | |
| 12 | Slope Cutting/Benching Maintained | | |
| 13 | Excavated soil / Construction Material / equipment kept away from the edge. | | |
| 14 | First aid in attendance. | | |
| 15 | Any other Precautions or Permits required (Height Work, Confined Space etc.), give details and attach | | |

**Declaration:** ***All the points mentioned in the above checklist have been checked and found OK***

**Permit Receiver:**

| **Site Engineer (Sub- Contractor):** | | **Site Safety Officer (Sub-Contractor):** | |
|---|---|---|---|
| Signature: | | Signature: | |
| Name: | Designation: | Name: | Designation: |

**Permit Issuer:**

| **Engineer of Concerned Execution Department (BHEL):** | | **Site Safety Officer (BHEL):** | |
|---|---|---|---|
| Signature: | | Signature: | |
| Name: | Designation: | Name: | Designation: |

| **Package-in-charge (BHEL):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

***Verified by Customer Representative (if applicable), Name:*** _____***Sign:*** _____***Date:*** _____***Time:*** _____

**(* Permit valid for 7 days, subject to daily renewal, and extension as per overleaf instructions / record formats)**

Excavation Work Permit No. & Date: _____

**Daily Work Area Condition Endorsement**

| Sl. No. | Date | Signature with Date & Time | | Remarks |
|---|---|---|---|---|
| | | Agency Safety | BHEL Safety | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |

**Permit Extension Beyond Initially Requested Hours**

| Sl. No. | Extension Period | | Remarks | Signature with Date & Time | | | |
|---|---|---|---|---|---|---|---|
| | From……. (Date & Time) | To…… (Date &Time) | | Agency Site Engineer | Agency Safety Officer | BHEL Site Engineer (PIA) | BHEL Safety Officer |
| **1.** | | | | | | | |
| **2.** | | | | | | | |
| **3.** | | | | | | | |
| **4.** | | | | | | | |
| **5.** | | | | | | | |
| **6** | | | | | | | |

| **TO BE SIGNED BY THE BHEL HSE & EXECUTION AFTER THE WORK IS OVER** | |
|---|---|
| **Permit is here by returned after completing the job & ensuring safe removal of men and material.** | |
| **Site Engineer, BHEL** | **Site HSE Engineer, BHEL** |
| Signature: | Signature: |
| Name: | Name: |

***General Instructions:***

| | |
|---|---|
| 1 | This Permit is required for all excavation tasks 1.22 mtr or deeper |
| 2 | This permit must be available at the work site all the times of the work. |
| 3 | Location and description of the work must be clearly indicated by the permittee. |
| 4 | Terms applicable must be clearly indicated by the permittee. |
| 5 | This permit shall be endorsed each day after checking all the compliance jointly by the contractor and BHEL safety. |
| 6 | Permit shall be issued for not more than **7 days** including the issue date. |
| 7 | Permit shall be returned to the HSE Department of BHEL after completion of the job. |
| 8 | Before engaging anybody to work, competency and fitness to be ensured. |
| 9 | All safety precautions to be taken as per work site HSE plan. |
| **10** | **Distribution of copy:** |
| | Original- Permittee, Duplicate –Department HOS, Contractor, Triplicate - Site HSE Dept., |

HSEP:14-FP05

| RADIATION WORK PERMIT | Permit No. & Date |
|---|---|
| Project & Unit: | Emergency Contact Nos: |
| BHEL Sub-contractor: | |

Exact Location of Work:_____

Nature / Description of Work:_____

Duration of Work Execution *: From Date:_____to Date:_____Daily from _____ hrs. to _____hrs.

Name of Sub-Contractor Performing the Work: _____

Name of Sub-Contractor's Site Engineer (Permit Requesting Authority):_____Sign:_____

Name of Sub-Contractor's Package In-charge:_____Sign:_____Date:_____

*The above described work will be done under all the safety precautions mentioned as under during the currency of the Permit.*

| No. | Item | Yes | Not required / Remarks |
|---|---|---|---|
| 1. | All the persons at the site informed/removed from the area. | | |
| 2. | Area around the source of radiation cordoned off with the rope/chord. | | |
| 3. | Radiation warning symbol/boards displayed around radiography work on rope/chord. | | |
| 4. | Radiographer worn radiation badges during testing and is within safe limits. | | |
| 5. | Radiography camera and carrying case box having radiation symbol. | | |
| 6. | Radiation Survey Meter is in working condition, calibrated & within validity period. | | |
| 7. | Radiographer has valid certificate from BARC. | | |
| 8. | Blinking light provided on road during radiography (in dark hours). | | |
| 9. | Proper required Illumination provided | | |
| 10. | Safe access and working platform provided to conduct RT work | | |
| 11. | All the persons involved in Radiography work are aware of the hazard of radiation | | |
| 12. | Any other Precautions or Permits required (Height Work, Confined Space etc.), give details and attach | | |

**Declaration:** ***All the points mentioned in the above checklist have been checked and found OK***

**Permit Receiver:**

| Site Engineer (Sub- Contractor): | |
|---|---|
| Signature: | |
| Name: | Designation: |

| Site Safety Officer (Sub-Contractor): | |
|---|---|
| Signature: | |
| Name: | Designation: |

**Permit Issuer:**

| Engineer of Concerned Execution Department (BHEL): | |
|---|---|
| Signature: | |
| Name: | Designation: |

| Site Safety Officer (BHEL): | |
|---|---|
| Signature: | |
| Name: | Designation: |

| Package-in-charge (BHEL): | |
|---|---|
| Signature: | |
| Name: | Designation: |

***Verified by Customer Representative (if applicable), Name: Sign: Date: Time:***

**(* Permit valid for 7 days, subject to daily renewal, and extension as per overleaf instructions / record formats)**

Radiation Work Permit No. & Date: _____

**Daily Work Area Condition Endorsement**

| Sl. No. | Date | Signature with Date & Time | | Remarks |
|---|---|---|---|---|
| | | Agency Safety | BHEL Safety | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |

**Permit Extension Beyond Initially Requested Hours**

| Sl. No. | Extension Period | | Remarks | Signature with Date & Time | | | |
|---|---|---|---|---|---|---|---|
| | From……. (Date & Time) | To…… (Date &Time) | | Agency Site Engineer | Agency Safety Officer | BHEL Site Engineer (PIA) | BHEL Safety Officer |
| **1.** | | | | | | | |
| **2.** | | | | | | | |
| **3.** | | | | | | | |
| **4.** | | | | | | | |
| **5.** | | | | | | | |
| **6** | | | | | | | |

| **TO BE SIGNED BY THE BHEL HSE & EXECUTION AFTER THE WORK IS OVER** | |
|---|---|
| **Permit is here by returned after completing the job & ensuring safe removal of men and material.** | |
| **Site Engineer, BHEL** | **Site HSE Engineer, BHEL** |
| Signature: | Signature: |
| Name: | Name: |

***General Instructions:***

| | |
|---|---|
| 1 | This Permit is required for all activities in which there is danger of exposure to harmful radiation |
| 2 | This permit must be available at the work site all the times of the work. |
| 3 | Location and description of the work must be clearly indicated by the permittee. |
| 4 | Terms applicable must be clearly indicated by the permittee. |
| 5 | This permit shall be endorsed each day after checking all the compliance jointly by the contractor and BHEL safety. |
| 6 | Permit shall be issued for not more than **7 days** including the issue date. |
| 7 | Permit shall be returned to the HSE Department of BHEL after completion of the job. |
| 8 | Before engaging anybody to work, competency and fitness to be ensured. |
| 9 | All safety precautions to be taken as per work site HSE plan. |
| **10** | **Distribution of copy:** |
| | Original- Permittee, Duplicate –Department HOS, Contractor, Triplicate - Site HSE Dept., |

HSEP:14-FP06

| LIFTING ACTIVITY WORK PERMIT | Permit No. & Date |
|---|---|
| Project & Unit: | Emergency Contact Nos: |
| BHEL Sub-contractor: | |

Exact Location of Work:_____

Nature / Description of Work:_____

Duration of Work Execution *: From Date:_____to Date:_____Daily from _____ hrs. to _____hrs.

Name of Sub-Contractor Performing the Work: _____

Name of Sub-Contractor's Site Engineer (Permit Requesting Authority):_____Sign:_____

Name of Sub-Contractor's Package In-charge:_____Sign:_____Date:_____

*The above described work will be done under all the safety precautions mentioned as under during the currency of the Permit.*

| No. | Item | Yes | Not required / Remarks |
|---|---|---|---|
| 1. | Crane used for lifting activity TPI tested, certified and approved for rated lifting | | |
| 2. | All lifting tackles, gears/appliances are tested and certified for lifting works. | | |
| 3. | Crane operator is trained and competent for lifting operation. | | |
| 4. | Lifting sling/ belt is protected against sharp edge of the jobs to be lifted. | | |
| 5. | Lifting hook is properly latched to prevent material falling over | | |
| 6. | Access and exit marked and without obstruction. | | |
| 7. | In case of lifting multiple materials at once, same are tied up with strong rope / material | | |
| 8. | Area below lifting activity barricaded to prevent movement | | |
| 9. | Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted. | | |
| 10. | Periphery area of crane booms as well as lifting job is barricaded and unauthorized/no-entry sign board posted. | | |
| 11. | Rigger and signal man is trained and competent for lifting work. Signal is clearly visible to the operator and understood | | |
| 12. | No lifting activity to be carried out during lightening, heavy wind/rain. No forecast of these conditions during work period | | |
| 13. | If scaffolding to be used during lift, scaffolding with valid tag available for use. | | |
| 14. | Add drawing /procedure etc. relevant for the lifting. | | |
| 15. | Any other Precautions or Permits required (Height Work, Confined Space etc.), give details and attach | | |

**Declaration:** ***All the points mentioned in the above checklist have been checked and found OK***

**Permit Receiver:**

| Site Engineer (Sub- Contractor): | |
|---|---|
| Signature: | |
| Name: | Designation: |

| Site Safety Officer (Sub-Contractor): | |
|---|---|
| Signature: | |
| Name: | Designation: |

**Permit Issuer:**

| Engineer of Concerned Execution Department (BHEL): | |
|---|---|
| Signature: | |
| Name: | Designation: |

| Site Safety Officer (BHEL): | |
|---|---|
| Signature: | |
| Name: | Designation: |

| Package-in-charge (BHEL): | |
|---|---|
| Signature: | |
| Name: | Designation: |

***Verified by Customer Representative (if applicable), Name:*** _____***Sign:*** _____***Date:*** _____***Time:*** _____

**(* Permit valid for 7 days, subject to daily renewal, and extension as per overleaf instructions / record formats)**

Lifting Activity Work Permit No. & Date: _____

**Daily Work Area Condition Endorsement**

| Sl. No. | Date | Signature with Date & Time | | Remarks |
|---|---|---|---|---|
| | | Agency Safety | BHEL Safety | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |

**Permit Extension Beyond Initially Requested Hours**

| Sl. No. | Extension Period | | Remarks | Signature with Date & Time | | | |
|---|---|---|---|---|---|---|---|
| | From……. (Date & Time) | To…… (Date &Time) | | Agency Site Engineer | Agency Safety Officer | BHEL Site Engineer (PIA) | BHEL Safety Officer |
| **1.** | | | | | | | |
| **2.** | | | | | | | |
| **3.** | | | | | | | |
| **4.** | | | | | | | |
| **5.** | | | | | | | |
| **6** | | | | | | | |

| **TO BE SIGNED BY THE BHEL HSE & EXECUTION AFTER THE WORK IS OVER** | |
|---|---|
| **Permit is here by returned after completing the job & ensuring safe removal of men and material.** | |
| **Site Engineer, BHEL** | **Site HSE Engineer, BHEL** |
| Signature: | Signature: |
| Name: | Name: |

***General Instructions:***

| | |
|---|---|
| 1 | This Permit is required for all Heavy Lifting Activities that are either / all of the following: 1. Above 50 Tons; 2. Tandem Lifting; 3. Total Load exceeding 75%of capacity of crane; 4. Lift of unusual difficulty or geometry or rigging; 5. Lift over operating Units; 6. Any other Lift as decided by Site HSE / Erection |
| 2 | Job Safety Analysis (**JSA**) to be created for every Lift above 5 Tons. |
| 3 | This permit must be available at the work site all the times of the work. |
| 4 | Location and description of the work, and terms applicable must be clearly indicated by the permittee. |
| 5 | This permit shall be endorsed each day after checking all the compliance jointly by the contractor and BHEL safety. |
| 6 | Permit shall be issued for not more than **7 days** including the issue date. |
| 7 | Permit shall be returned to the HSE Department of BHEL after completion of the job. |
| 8 | Before engaging anybody to work, competency and fitness to be ensured. |
| 9 | All safety precautions to be taken as per work site HSE plan. |
| **10** | **Distribution of copy:** Original- Permittee, Duplicate –Department HOS, Contractor, Triplicate - Site HSE Dept. |

HSEP:14-FP07

| LOCKOUT/TAGOUT *(LIVE ELECTRICAL MAINTENANCE)* WORK PERMIT | Permit No. & Date |
|---|---|
| **Project & Unit:** | **Emergency Contact Nos:** |
| **BHEL Sub-contractor:** | |

Exact Location of Work:_____

Nature / Description of Work:_____

Duration of Work Execution *: From Date:_____to Date: _____Daily from _____ hrs. to _____hrs.

Name of Sub-Contractor Performing the Work: _____

Name of Sub-Contractor's Site Engineer (Permit Requesting Authority):_____Sign:_____

Name of Sub-Contractor's Package In-charge:_____Sign:_____Date:_____

*The above described work will be done under all the safety precautions mentioned as under during the currency of the Permit.*

| Tag No. | Device to be Tagged / Locked I.D. No. | Device Location | Device Position *OPEN / CLOSED - ON/OFF* | Lock No. | Tag Lock Placed by Name/Sign - Date/Time | | Tag / Lock Removed by Name/Sign - Date/Time | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
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| | | | | | | | | |

**Declaration:** ***All the points mentioned in the above checklist have been checked and found OK***

**Permit Receiver:**

| **Site Engineer (Sub- Contractor):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

| **Site Safety Officer (Sub-Contractor):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

**Permit Issuer:**

| **Engineer of Concerned Execution Department (BHEL):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

| **Site Safety Officer (BHEL):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

| **Package-in-charge (BHEL):** | |
|---|---|
| Signature: | |
| Name: | Designation: |

***Verified by Customer Representative (if applicable), Name:*** _____***Sign:*** _____***Date:*** _____***Time:*** _____

**(* Permit valid for 7 days, subject to daily renewal, and extension as per overleaf instructions / record formats)**

Lockout/Tagout Work Permit No. & Date: _____

**Daily Work Area Condition Endorsement**

| Sl. No. | Date | Signature with Date & Time | | Remarks |
|---|---|---|---|---|
| | | Agency Safety | BHEL Safety | |
| Day 2 | | | | |
| Day 3 | | | | |
| Day 4 | | | | |
| Day 5 | | | | |
| Day 6 | | | | |
| Day 7 | | | | |

**Permit Extension Beyond Initially Requested Hours**

| Sl. No. | Extension Period | | Remarks | Signature with Date & Time | | | |
|---|---|---|---|---|---|---|---|
| | From……. (Date & Time) | To…… (Date &Time) | | Agency Site Engineer | Agency Safety Officer | BHEL Site Engineer (PIA) | BHEL Safety Officer |
| **1.** | | | | | | | |
| **2.** | | | | | | | |
| **3.** | | | | | | | |
| **4.** | | | | | | | |
| **5.** | | | | | | | |
| **6** | | | | | | | |

| **TO BE SIGNED BY THE BHEL HSE & EXECUTION AFTER THE WORK IS OVER** | |
|---|---|
| **Permit is here by returned after completing the job & ensuring safe removal of men and material.** | |
| **Site Engineer, BHEL** | **Site HSE Engineer, BHEL** |
| Signature: | Signature: |
| Name: | Name: |

***General Instructions:***

| | |
|---|---|
| 1 | This Permit is required for all maintenance and erection activities with danger of electrocution from Live Electric Power |
| 2 | This permit must be available at the work site all the times of the work. |
| 3 | Location and description of the work, and terms applicable must be clearly indicated by the permittee. |
| 4 | This permit shall be endorsed each day after checking all the compliance jointly by the contractor and BHEL safety. |
| 5 | Permit shall be issued for not more than **7 days** including the issue date. |
| 6 | Permit shall be returned to the HSE Department of BHEL after completion of the job. |
| 7 | Before engaging anybody to work, competency and fitness to be ensured. |
| 8 | All safety precautions to be taken as per work site HSE plan. |
| **9** | **Distribution of copy:** Original- Permittee, Duplicate –Department HOS, Contractor, Triplicate - Site HSE Dept. |

| | POWER SECTOR | FORMAT NO: **HSEP:14-F01**<br>REV NO.: 00<br>PAGE NO. 01 OF 02 |
|---|---|---|
| | Inspection of First Aid Box | |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor:** | |
| **Inspected by :** | |
| **Date of Inspection:** | |

**Number of employees in the site: -_____**

| Sl. No. | Item | No. Available | Remarks |
|---|---|---|---|
| 1 | No. of small sterilized dressings | | |
| 2 | No of medium sized sterilized dressings | | |
| 3 | No of large sized sterilized dressings. | | |
| 4 | No of large sized sterilized burn dressings | | |
| 5 | No of (15 grams) packets sterilized cotton wool | | |
| 6 | No of pieces of sterilized eye pads in separate sealed packets. | | |
| 7 | No of roller bandages 10 cm wide. | | |
| 8 | No of roller bandages 5 cm wide. | | |
| 9 | Whether tourniquet available | | |
| 10 | Whether supply of suitable splints available. | | |
| 11 | No of packets of safety pins. | | |
| 12 | Whether kidney tray available | | |
| 13 | Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available. | | |
| 14 | Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available. | | |
| 15 | Whether (60ml) bottle containing a two percent alcoholic solution of iodine available | | |
| 16 | Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available. | | |
| 17 | Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, | | |
| 18 | Whether roll of adhesive plaster (6 cm X 1 meter) available | | |

| Sl. No. | Item | No. Available | Remarks |
|---|---|---|---|
| 19 | No of rolls of adhesive plaster (2 cm X 1 meter) | | |
| 20 | Whether snake bite lancet available. | | |
| 21 | Whether (30 grams) bottle of potassium permanganate crystals available. | | |
| 22 | Whether a pair scissors available | | |
| 23 | Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labor Institutes, Government of India available. | | |
| 24 | Whether bottle containing 100 tablets (each of 5 grains) of aspirin available | | |
| 25 | Whether Ointment for burns available | | |
| 26 | Whether bottle of a suitable surgical anti-septic solution available | | |
| 27 | Whether List of Contents pasted on First Aid Box along with respective expiry dates | | |

**Signature of Subcontractor's Site I/C** **Date:**

| | POWER SECTION | FORMAT NO: **HSEP:14-F02**<br>REV NO.: 00<br>PAGE NO. 01 OF 02 |
|---|---|---|
| | Health Check-Up | |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor:** | |
| **Name of Employee :** | |
| **Age:** | |

| | |
|---|---|
| History Of Past Illness | H/O Epilepsy: |
| | H/O Drug Allergy: |
| | H/O Diabetics/ Hypertension: |
| | H/O Unconsciousness: |
| Personal History | |

| **EXAMINATION** | **OBSERVATION** | |
|---|---|---|
| **General Physical Examination** | | |
| Height | | |
| Weight | | |
| BMI | | |
| Built And nourishment | | |
| Pallor | | |
| Temperature | | |
| Chest Expansion | Inspiration | Expansion |
| | | |
| Lymph Node Enlargement | | |
| Upper Limbs Strength & Function | | |
| Lower Limbs Strength & function | | |
| Spine Adequately flexible for the job concerned (Yes/No) | | |
| Mental alertness and stability with good eye, hand and foot co-ordination. | | |
| **Ear, Nose, Throat** | | |
| Ear / Hearing | | |
| Nose | | |
| Throat | | |
| **Vision** | | |
| Left Eye | Right Eye | |
| | | |

| EXAMINATION | OBSERVATION | |
|---|---|---|
| **Cardiovascular System Examination** | | |
| Inspection | | |
| Palpation | Pulse | BP |
| Auscultation (Heart Sounds) | | |
| **Respiratory System** | | |
| Inspection | Respiratory Rate | |
| Palpation: | | |
| Percussion | | |
| Auscultation (Breath Sounds) | | |
| **Examination of Abdomen** | | |
| Inspection | | |
| Palpation | | |
| Auscultation (Bowel Sounds) | | |
| **Any Other** | | |
| **Clinical Impression** | | |

**Signature of the examining doctor** **Date:**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>HSE Induction / Regular / On-the-Job Training Records | FORMAT NO: **HSEP:14-F03**<br>REV NO.: 02<br>PAGE NO. 01 OF 01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Name of Site :** | | | | | | |
| **Name of Sub-Contractor :** | | | | | | |
| **Date of Training (dd/mm/yyyy) :** | | **Duration (Hrs)** | | | | |
| | | **From** | | **To** | | |
| **Name & Details of Trainer:** | | | | | | |
| **Subject of Training** | **Induction** | | **On-The-Job Training (Give details)** | | | |
| **Name of Training Co-ordinator:** | | | | | | |

| Sl. No. | Name | Designation | Organization | Signature |
|---|---|---|---|---|
| | | | | |
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**I certify that Training has been carried out as per HSEP04: HSE Procedure for Training & Awareness**

**Signature of Training Coordinator** **Date:**

| | POWER SECTOR | FORMAT NO: **HSEP:14-F04**<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |
|---|---|---|
| | Toolbox Talk | |

| | |
|---|---|
| **Name of Site :** | |
| **Sub-Contractors Name :** | |
| **Date :** | |

| **Topic** | **Name of person delivered Tool Box Talk** | **No. of Participants attended** | **Remarks** |
|---|---|---|---|
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**Signature of Site I/C of Subcontractor** **Date:**

| **Name of subcontractor:** | **Report Month:** |
|---|---|
| | |

**A) Accidents/Incidents Details: -**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **a** | **Lost time in Accidents** | **No. of incidents** | **Man Hours Lost** | **No. of People Involved** | **No. of person reported to Govt.** | | |
| | For the Month | | | | | | |
| | Cumulative | | | | | | |
| **b** | **Minor Injuries** | | | | | | |
| | For the Month | | | | | | |
| | Cumulative | | | | | | |
| **c** | **Fires** | **No. of Near-Misses** | **No. of First- Aid cases** | **No. of persons injured** | **No. of equipment damaged** | **No. of Fire reported Outside** | |
| | For the Month | | | | | | |
| | Cumulative | | | | | | |
| **d** | **Other mishaps not covered in a, b, c.** | **No. of Near-Misses** | **No. of First- Aid cases** | **No. of persons injured** | **No. of equipment damaged** | **Total near misses and First-Aid** | |
| | For the Month | | | | | | |
| | Cumulative | | | | | | |

**B) Data for Man-hours worked:**

| **Details** | **Value** | **Remarks if any** |
|---|---|---|
| **No. of people** | | |
| **Man Hours worked** | | |
| **O.T. Hours** | | |
| **Total Man Hours** | | |
| **Grand Total of man hours worked during the month(A+B)** | | |
| **Cumulative man-hours (from_____to_____):<br>( Since commencing of operations)** | | |

**Signature of Subcontractor Site In-charge** **Signature of Subcontractor HSE Officer**

**C) Status of Deployment of Work force, Safety Officers/Supervisors & Construction Medical Officer(s) & Electricians:**

| Description | Name | Qualification & Experience |
|---|---|---|
| Safety Officers | | |
| | | |
| | | |
| | | |
| | | |
| Safety Supervisors | | |
| | | |
| | | |
| | | |
| | | |
| Construction Medical Officer | | |
| Nursing Staff. | | |
| Electricians | | |
| Scaffolding Inspectors | | |
| | | |
| T&P Inspectors | | |
| | | |

**D) Status of deployment of manpower for critical HSE activities:**

**(All height work and other hazardous activities to be actively supervised by trained personnel. Area to be divided in manageable sections to ensure effective supervision at all times. For example, multiple elevations in a structure can be divided among multiple supervisors)**

| Activity | Location | Shift Timings | Personnel deployed | Remarks |
|---|---|---|---|---|
| Height Work | Boiler Unit- (Level 1-3) | | | |
| | Boiler Unit- (Level 4-6) | | | |
| | ESP | | | |
| | | | | |
| | | | | |
| Housekeeping | Boiler Unit- | | | |
| | ESP Unit | | | |
| | | | | |
| Others | | | | |
| | | | | |

**Signature of Subcontractor Site In-charge** **Signature of Subcontractor HSE Officer**

**E) Lifting Tools, Tackles, Equipment and Pressure Vessels:**

| Item | Nos. Deployed | Nos. Tested by competent person | Identification Nos. (Comma separated) (A) | Validities of Test Certificates (Comma separated – corresponding to column A) | Whether internal testing using Color Coding or similar system done |
|---|---|---|---|---|---|
| Winches | | | | | |
| Chain Blocks | | | | | |
| Wire Rope Slings | | | | | |
| Man Cages | | | | | |
| D-Shackles | | | | | |
| Air Compressors | | | | | |
| Crawler Cranes | | | | | |
| Mobile Cranes | | | | | |
| Hydra Cranes | | | | | |
| Hydraulic Jack | | | | | |
| Others | | | | | |

**F) Reverse Horns in Construction Vehicles:**

| Item | Nos. Deployed with serial numbers (Comma separated) (A) | Nos. Having Functional reverse horns | Inspection Dates (Comma separated corresponding to column A) |
|---|---|---|---|
| Transit Mixers | | | |
| Hydra Cranes | | | |
| Dumpers/Trippers | | | |
| Backhoes | | | |
| Other Vehicles | | | |

**G) ELCBs:**

| No. Of ELCBs provided with Serial Nos. (Comma separated) (A) | Nos. Functional | When They were last Tested (Comma separated corresponding to column A) |
|---|---|---|
| | | |

**H) Electrical Earthing:**

| No. Of Earth resources with serial numbers and locations (Comma separated) (A) | Whether Double Earthing provided to all equipment | When they were last tested (Comma separated corresponding to column A) |
|---|---|---|
| | | |

**I) Fire Extinguishers**

Name & designation of person responsible for maintenance of Extinguishers at different locations :( Individual subcontractor's Safety Officers).

**A. FIRE EXITINGUISHERS AT ERECTION SITE:**

| Type (Add more rows if required) | Sizes | Qty + Serial numbers (Comma separated) (A) | Healthiness – Last checked dates (Comma separated corresponding to column A) | Locations (Comma separated corresponding to column A) |
|---|---|---|---|---|
| FOAM TYPE | | | | |
| SODA TYPE | | | | |
| DRY TYPE (DCP) | | | | |
| C02 TYPE | | | | |

**B. FIRE EXTINGUISHERS AT SITE OFFICES & STORES:**

| Type | Size (Add more rows if required) | Qty + Serial numbers (Comma separated) (A) | Healthiness – Last checked dates (Comma separated corresponding to column A) | Locations (Comma separated corresponding to column A) |
|---|---|---|---|---|
| FOAM TYPE | | | | |
| SODA TYPE | | | | |
| DRY TYPE (DCP) | | | | |
| C02 TYPE | | | | |

**J) Tie-Ups with Emergency Services**

| Service (Add more rows if required) | Name, location & distance from site | Emergency contact details | Remarks |
|---|---|---|---|
| Hospital with ICU and facilities for orthopedic, neurological etc. trauma | | | |
| Fire services | | | |
| Others: | | | |
| | | | |

**K) Implementation of Checklist, Work Permits:**

| Item | Numbers During the Month | Major Deviations |
|---|---|---|
| | | |
| | | |
| **Note:-** Please attach photocopies of all filled Checklists & Work permits for that month. | | |

**L) Personal Protective Equipment Issued (Extend table for each subcontractor):**

| Item | Issued this Month | Nos. Issued up to the Month | Percentage of usage at Site (as per physical verification) |
|---|---|---|---|
| **Name of subcontractor:** | | | |
| Safety Helmet | | | |
| Safety Shoes | | | |
| Full Body Harness | | | |
| Fall Arrestor | | | |
| Safety Nets | | | |
| Hand Gloves | | | |
| Face shield | | | |
| Welder shield | | | |
| Nose Mask | | | |
| Reflective Jacket | | | |
| Other PPEs. | | | |

**M) Safety Observations by Subcontractor Executives- Observations package wise:**

| Topic | Date Of Programme | No. Of Participants | Level Of Participants |
|---|---|---|---|
| | | | |

- **Tool-Box talks on Safety:**

| Date | Tool Box Talk - No of Participants | Topic | Remarks |
|---|---|---|---|
| | | | |
| | | | |

- **Safety Induction Trainings:**

| Date | Safety Induction No. of Participants | Topic | Remarks |
|---|---|---|---|
| | | | |
| | | | |

**Signature of Subcontractor Site In-charge** **Signature of Subcontractor HSE Officer**

**N) Progress of Management Programmes at Site**

| SL | Description Of MPs | Annual Plan | Achievement In This Month | Cumulative Achievement |
|---|---|---|---|---|
| **A. Environment Improvement Programme** | | | | |
| 1 | Plantation of Trees | | | |
| 2 | Installation of Scrap Bins | | | |
| 3 | Chemical Storage & Handling system | | | |
| **B. Improvement of Working Environment** | | | | |
| 4 | Increasing LTI free days | | | |
| 5 | Air Quality Monitoring | | | |
| 6 | Water Quality Monitoring | | | |
| 7 | Illumination level Monitoring | | | |

**O) HR Information:**

| Designation | Total No. Inducted | Total no. of Induction Balance | Total no. of Gate Pass Issued | Total no. of Gate Pass Balance | Total no. of Gate Pass Cancelled | Medical Checkup Completed | Medical Checkup Balance |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |

**P) Rewards on Account of Good Safety Performance**

| Serial Number | Reward Issued to | Details of Reward Issued (Amount etc.) | Brief Reason |
|---|---|---|---|
| | | | |
| **Note:** Photos of Reward Functions to be attached | | | |

**Q) Other Safety initiatives / Safety Activities conducted (with photos, if any):**

**Signature of Subcontractor Site In-charge** **Signature of Subcontractor HSE Officer**

| | POWER SECTOR | FORMAT NO: **HSEP:14-F06**<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |
|---|---|---|
| | Personal Protective Equipment Inspection | |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection:** | |

| Item | Total Checked | Numbers Found in Order | Remarks |
|---|---|---|---|
| **Safety Helmet** | | | |
| **Safety Shoes** | | | |
| **Full Body Harness** | | | |
| **Fall Arrestor** | | | |
| **Safety Nets** | | | |
| **Hand Gloves** | | | |
| **Face shield** | | | |
| **Welder shield** | | | |
| **Nose Mask** | | | |
| **Reflective Jacket** | | | |
| **Other PPEs (Specify)** | | | |

**Signature of Site I/C of Subcontractor:** **Date:**

| | POWER SECTOR | FORMAT NO: **HSEP:14-F06**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |
|---|---|---|
| | **Format for Register of Issue and Receipt of PPEs** | |

**Site:**

**Subcontractor:**

| S.N | Name of Person | Details of PPE(s) Issued (with Serial Numbers) | Date Issued | Receiver's Signature | Issuer's Name & Designation | PPE's verified OK / Remarks | Issuer's Signature |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |
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| | | | | | | | |

| | | |
|---|---|---|
| | **POWER SECTOR**<br>Inspection Of T&Ps | FORMAT NO: **HSEP:14-F07**<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Date of Inspection :** | |

| **Sl.No.** | **Description** | **Remarks** |
|---|---|---|
| 1.0 | Name of equipment | |
| 2.0 | Basic Information of equipment | |
| 2.1 | Specification | |
| 2.2 | Sr. No. of equipment | |
| 2.3 | Make | |
| 2.4 | Year of manufacture | |
| 3.0 | Major repairs / overhauls(Furnish details of work carried out) | Date(s) of major repair/overhaul |
| 3.1 | | |
| 3.2 | | |
| 3.3 | Repairs carried out at site | |
| | | |
| 4.0 | Any performance test conducted | Yes/No |
| 5.0 | Document Submitted | Yes/No |
| 6.0 | Manufacturer's test / guarantee certificate | Available/ Not available |
| 7.0 | Performance test | Done/ Not Done |
| 8.0 | Acceptance Norms | |
| 9.0 | Committee Observations | |
| 10.0 | Date of next review (if accepted) | |

| | |
|---|---|
| **Signature-Subcontractor HSE Officer** | **Signature-Subcontractor Site In-charge** |

| | | |
|---|---|---|
| | **POWER SECTOR** | FORMAT NO: **HSEP:14-F08**<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |
| | Inspection Of Cranes | |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection:** | |

**Crane Reg. No (Make/Model)** _____

**Name of Driver/Operator** _____

| Sl.no. | Description | Observation | Measures |
|---|---|---|---|
| 1 | Valid Driving license | | |
| 2 | Hook & Hook Latch | | |
| 3 | Over Hoist limit switch | | |
| 4 | Boom limit switch | | |
| 5 | Boom Angle Indicator | | |
| 6 | Boom limit cutoff switch | | |
| 7 | Condition of Boom | | |
| 8 | Condition of ropes | | |
| 9 | Number of load lines | | |
| 10 | Size and condition of the slings | | |
| 11 | Stability of the cranes | | |
| 12 | Soil Condition | | |
| 13 | Swing Break And Lock | | |
| 14 | Proper Break And Lock | | |
| 15 | Hoist Break And Lock | | |
| 16 | Boom Break And Lock | | |
| 17 | Main Clutch | | |
| 18 | Leakage in Hydraulic Cylinders | | |
| 19 | Out riggers filly extendable | | |
| 20 | Tyre pressure | | |
| 21 | Condition of Battery And Lamps | | |
| 22 | Guards of moving and rotating parts | | |
| 23 | Load chart provided | | |
| 24 | Number and position of pedant ropes | | |
| 25 | Reverse Horn | | |
| 26 | Load Test Details | | |
| 27 | Operator's fitness | | |
| 28 | Pollution under control certificate | | |
| 29 | Fire extinguisher of appropriate type. | | |
| 30 | Training of the operator | | |

**Signature of Site I/C of Subcontractor:** **Date:**

| | POWER SECTOR | FORMAT NO: **HSEP:14-F09**<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |
|---|---|---|
| | Inspection Of Winches | |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection:** | |

**Winch Reg. No (Make/Model)** _____

**Name of Operator** _____

| Sl. No. | Description | YES | NO | NA | Remarks |
|---|---|---|---|---|---|
| 1 | Has the copy of Third Party Inspection certificate been provided in winch machine shed? | | | | |
| 2 | Is safe operating instructions displayed near winch? | | | | |
| 3 | Is winch machine operator experienced enough to operate the winch machine? | | | | |
| 4 | Is the winch machine operated by someone other than the winch machine operator? | | | | |
| 5 | Is there guard provided in all moving parts like wheel and motor's shaft? | | | | |
| 6 | Will it protect against unforeseen operational contingencies? | | | | |
| 7 | Are brakes, clutch and locking arrangement working properly? | | | | |
| 8 | Has it been ensured that the guard does not constitute a hazard by itself? | | | | |
| 9 | Are the cranks and the connecting rods protected by guardrails? | | | | |
| 10 | Is there provision for fully covered shed with wooden plank roof? | | | | |
| 11 | Is wire rope free from any kind of damage or wear and tear? | | | | |
| 12 | Is split pin provided for the protection of clutch and brake locking arrangement? | | | | |
| 13 | Is pulley inspected by competent person and certified before use? | | | | |
| 14 | Is pulley free from any wear and tear visually? | | | | |
| 15 | Is winch rope barricaded with clipsheet for the protection of rope and person? | | | | |
| 16 | Is the wire rope lubricated by cardium oil? | | | | |
| 17 | Is there any friction in wire rope which may damage the wire rope rather than the rolling parts? | | | | |
| 18 | Is there any oil leakage in the hydraulic system of the winch machine? | | | | |
| 19 | Has it been ensured that the guard will not cause discomfort or inconvenience to operator? | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Total NO** | | **Total NA** | | **% Compliance** | |

**Signature of Site I/C of Subcontractor:** **Date:**

| | POWER SECTOR | FORMAT NO: **HSEP:14-F10**<br>REV NO.: 00<br>PAGE NO. 01 OF 2 |
|---|---|---|
| | Inspection of Height Working | |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection:** | |

| Sl. No. | Descriptions | Observation (Yes/No) | Remarks |
|---|---|---|---|
| | A. General | | |
| 1 | All the workers have been explained safe work method? | | |
| 2 | Adequate illumination has been ensured. | | |
| 3 | Work area inspected prior to the start of the work. | | |
| 4 | Is the work area barricaded to prevent fall and platforms are of adequate strength (bamboo, jute / plastic ropes not to be used). | | |
| 5 | The temporary work platforms & structures for height work including those used in Boiler structures, water walls, ESP, Powerhouse are fully barricaded with railings (as per **IS 3696**) | | |
| 6 | Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc. | | |
| 7 | Are floor gaps, permanently covered and barricaded | | |
| 8 | Area below the work place barricaded, particularly below hot work. | | |
| 9 | Workers provided with bags /box to carry bolts, nuts and hand tools | | |
| 10 | Arrangement for fastening hand tools made. | | |
| 11 | All work platforms ensured to be of adequate strength and ergonomically suitable. | | |
| 12 | Work at more than one elevation at the same segment is restricted. | | |
| 13 | An established communication system has been established and explained to the workers. | | |
| | B. **Access/Egress** | | |
| 1 | Walkways provided with handrail, mid-rail and toe guard? | | |
| 2 | All checkered plates, gratings properly welded/ bolted? | | |
| 3 | Are ladders inspected and they are in good condition? | | |
| 4 | Are ladders spliced? | | |
| 5 | Are ladders properly secured to prevent slipping, sliding or falling? | | |
| 6 | Stairs erected above and below 1 tier column for safe access? | | |
| 7 | Do side rails extend 36” above top landing? | | |

| Sl. No. | Descriptions | Observation (Yes/No) | Remarks |
|---|---|---|---|
| 8 | Are built up ladders constructed of sound materials? | | |
| 9 | Are rugs and cleats not over 12" on center? | | |
| 10 | Metal ladders not used around electrical hazards. | | |
| 11 | Proper maintenance and storage. | | |
| 12 | Ladders placed at right slope. | | |
| 13 | Ladders / staircases welded/ bolted properly. | | |
| 14 | Any obstruction in the stairs. | | |
| 15 | Are landing provided with handrails, knee rails, toe boards etc.? | | |
| 16 | Whether ramp is provided with proper slope. | | |
| 17 | Proper hand rails / guards provided in ramps. | | |
| C. **Housekeeping** | | | |
| 1 | Walkways, aisles & all overhead workplaces cleared of loose material. | | |
| 2 | Is any nut bolt/scrap left on beam/column? | | |
| 3 | Flammable materials, if any, are cleared. | | |
| 4 | All the de shuttering materials are removed after de shuttering is done. | | |
| 5 | Platforms and walkways free from oil/grease or other slippery material. | | |
| 6 | Collected scrap are brought down or lowered down and not dropped from height. | | |
| D. **PPE And Safety Devices** | | | |
| 1 | Use of safety helmet, safety belts ensured for all workers | | |
| 2 | Anchoring points provided at all places of work. | | |
| 3 | Common lifeline provided wherever linear movement at height is required. | | |
| 4 | Safety nets are use wherever required. | | |
| 5 | Proper fall arrest system is deployed at critical workplaces. | | |
| 6 | Crawler boards/Safety system or works on fragile roof are used. | | |
| 7 | Is man-lift being used for personnel lifting? | | |
| 8 | Does man basket / personnel lift system has an independent lifeline and all occupants safety harnesses connected to it with rope grab? | | |

**Signature of Site I/C of Subcontractor:** **Date:**

| | | |
|---|---|---|
| | **POWER SECTOR** | FORMAT NO: **HSEP:14-F11** |
| | Inspection of Welding and Gas Cutting | REV NO.: 00<br>PAGE NO. 01 OF 02 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection :** | |

| **Welding** | | | | |
|---|---|---|---|---|
| Sl.no. | Description | Yes | No | Remarks |
| 1 | Is electric connection given through 30 mA ELCB/RCCB to welding m/c? | | | |
| 2 | Is welding machine more than 10 years old? | | | |
| 3 | Is there provision of fuse and is it bypassed? | | | |
| 4 | Is electric cable fitted properly in junction box on m/c? | | | |
| 5 | Is electrical cable free from joints? | | | |
| 6 | Are the joints attached firmly & insulated with tape? | | | |
| 7 | Is double earthing given to body of m/c? | | | |
| 8 | Is the physical condition of the m/c good? | | | |
| 9 | Is ON/OFF switch connected to the m/c is working and in good condition? | | | |
| 10 | Are indication lamps on m/c working? | | | |
| 11 | Is the electrode holder in good condition? | | | |
| 12 | Are the cables of the welding m/c lugged & tight properly? | | | |
| 13 | Is cable to welding machine terminal joint lose / burnt / glowing? | | | |
| 14 | Are return lead connected properly<br>(Rod, Angle, Channels shall not be used) | | | |
| | Total No of NO | | | |
| | Total No of YES | | | |

**Signature of Site I/C of Subcontractor:** **Date:**

| | POWER SECTOR | FORMAT NO: **HSEP:14-F11**<br>REV NO.: 00<br>PAGE NO. 02 OF 02 |
|---|---|---|
| | Inspection of Welding and Gas Cutting | |

| **Gas Cutting** | | | | |
|---|---|---|---|---|
| **Sl.no** | Description | Yes | No | Remarks |
| **1** | Are Cylinders kept on trolleys? | | | |
| **2** | Physical condition of Gas cylinders Good? | | | |
| **3** | Is there Oil/Grease on valve of the cylinder? | | | |
| **4** | Are pressure regulators in good condition? | | | |
| **5** | Condition of hose pipe OK? | | | |
| **6** | Are hose pipe clamped with hose clip? | | | |
| **7** | Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder? | | | |
| **8** | Is nozzle of the torch cleaned? | | | |
| | Total Number of NO | | | |
| | Total No of YES | | | |
| | **% Compliance** | | | |

**Signature of Site I/C of Subcontractor:** **Date:**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Inspection Of Electrical Installation** | FORMAT NO: **HSEP:14-F12**<br>REV NO.: 00<br>PAGE NO. 01 OF 02 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection :** | |

| **Sr. No.** | **Contents** | **Yes/No** | **Remarks** |
|---|---|---|---|
| **A** | **Cable** | | |
| 1. | Whether the condition of cable is checked? | | |
| 2. | Are cables received from other sites checked for insulation resistance before putting them into use? | | |
| 3. | Are all main cables taken either underground / overhead? | | |
| 4. | Are welding cables routed properly above the ground? | | |
| 5. | Are welding and electrical cables overlapping? | | |
| 6. | Is any improper joining of cables/wires prevailing at site? | | |
| **B** | **DBs/SDBs** | | |
| 1. | Is earth conductor continued up to DB / SDB? | | |
| 2. | Whether DBs and extension boards are protected from rain / water? | | |
| 3. | Whether DB and extension board have separate MCB/ELCB | | |
| 4. | Is there any overloading of DBs / SDBs? | | |
| 5. | Are correct / proper fuses & CBs provided at main boards and sub-boards? | | |
| 6. | Is energized wiring in junction boxes, CB panels & similar places covered all times? | | |
| **C** | **ELCB** | | |
| 1. | Whether the connections to all equipment are routed through individual ELCBs? | | |
| 2. | Is sensitivity of each ELCB maintained at 30 mA? | | |

| Sr. No. | Contents | Yes/No | Remarks |
|---|---|---|---|
| 3. | Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person? | | |
| **D** | **Grounding** | | |
| 1. | Is natural earthing ensured at the source of power (main DB at Generator or Transformer)? | | |
| 2. | Whether the continuity and tightness of the earth conductor are checked? | | |
| 3. | Mention the gauge of the earth conductor used at the site. | | |
| 4. | Mention the value of Earth Resistance. | | |
| **E** | **Electrically operated Machines or Accessories**. | | |
| 1. | Whether the plug top is provided everywhere. | | |
| 2. | Are all metal parts of electrical equipment and light fittings / accessories grounded / double earthed? | | |
| 3. | Is there any shed or cover for welding machines? | | |
| 4. | Are halogen lamps fixed at proper places? | | |
| 5. | Are portable power tools maintained as per norms? | | |
| 6. | Any other information: | | |

**Signature of Site I/C of Subcontractor:** **Date:**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Inspection of Elevator** | FORMAT NO: **HSEP:14-F13**<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection :** | |

| **Sr. No.** | **Description** | **Remarks** |
|---|---|---|
| 1.0 | Name of equipment | |
| 2.0 | Basic Information of equipment | |
| 2.1 | Specification | |
| 2.2 | Sr. No. of equipment | |
| 2.3 | Make | |
| 2.4 | Year of manufacture | |
| 3.0 | Major repairs/overhauls(Furnish details of work carried out) | Date(s) of major repair/overhaul |
| 3.1 | | |
| 3.2 | | |
| 3.3 | Repairs carried out at site | |
| | | |
| 4.0 | Any performance test conducted | Yes/No |
| 5.0 | Document Submitted | Yes/No |
| 6.0 | Manufacturer's test / guarantee certificate | Available/ Not available |
| 7.0 | Performance test | Done/ Not Done |
| 8.0 | Acceptance Norms | |
| 9.0 | Committee Observations | |
| 10.0 | Date of next review (if accepted) | |

**Signature-Subcontractor/ Subcontractor's Safety Officer** **Signature-Site Safety Officer ( BHEL)**

| | | |
|---|---|---|
| BHEL | **POWER SECTOR**<br>**HSE Penalty Format** | FORMAT NO: **HSEP:14-F14**<br>REV NO.: 00<br>PAGE NO. 01 OF 2 |

**Sub: MEMO for Penalty for non-compliances in Safety and Fabrication Quality requirement**

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences may please be avoided in future.

| S. No | Nature of Non - Compliance | Penalty (in Rs.) | Remarks |
|---|---|---|---|
| | **A. PPEs** | | |
| 1. | Not wearing safety helmet / wearing without chin straps | 500 | Per Person/ day |
| 2. | Not Wearing safety shoes | 500 | Per Person/ day |
| 3. | Not wearing gloves, nose masks where required | 350 | Per Person/ day |
| 4. | Not using grinding goggles while doing grinding operations | 500 | Per Person/ day |
| | **B. Height Work** | | |
| 1. | Not providing Lifelines for height work | 1000 | Per location per day |
| 2. | Not ensuring barricading of working platforms | 1000 | Per location per day |
| 3. | Not using temporary platform during work at height | 1000 | Per case per day |
| 4. | Not wearing safety belt while working at height (> 2 meters) or not anchoring to lifeline | 2000 | Per Person/ day |
| 5. | Not providing proper barricades (caution tape at 2 elevations) | 500 | Per location per day |
| | Use of mobile phones by Height worker / Crane / Hydra Operator | 1000 | Per case per day |
| | **C. Electrical** | | |
| 1. | Not using 24 V supply for lighting in confined spaces | 500 | Per case per day |
| 2. | Lack of Electrical Earthing | 2000 | Per case per day |
| 3. | Improper earthing of welding & Other electrical Machines. Earth resistance not OK | 500 | Per Machine per incidence |
| 4. | Electrical plug not used for connection/ hand machines | 500 | Per connection per incidence |
| 5. | Unsafe electrical practice like not installing ELCB/ RCCB | 500 | Per case per day |
| 6. | Using frayed/ broken welding cables | 500 | Per machine per week |
| | **D. Lifting** | | |
| 1. | Use of lifting equipment without having valid Third Party Test certificate | 5000 | Per equipment per seven days |
| 2. | Lifting hooks without latches | 500 | Per hook per day |
| 3. | Using damaged slings or not slinging properly | 2000 | Per event Per T&P |
| 4. | Lifting cylinders without cage or rolling of cylinders | 500 | Per Event per incidence |
| 5. | Non removal of scrap from platforms | 1000 | **Per Event Per location per 7 days** |
| | **E. Hot Work / Cylinder Handling** | | |
| 20. | Gas cutting without flash back arrestor | 2000 | Per machine per incidence |
| 21. | Gas cutting at height without sheet below | 500 | Per event |
| 22. | Not keeping gas cylinders vertically / in trolley on ground | 500 | Per event |
| 23. | Gas cutting with damaged hose pipes | 500 | Per event |
| | Not covering welding cylinder with top cover | 500 | Per event |
| | **F. Construction Vehicles** | | |
| 24. | Not having valid driving license for the type of vehicle/ T&P | 2000 | Per driver per event |
| 25. | Two wheeler entry in construction area | 500 | Per vehicle |
| 26. | Using Hydra for material movement at site in unsafe manner | 1000 | Per case |
| 27. | Using Two Hydra in Tandem for material movement | 2000 | Per case |
| 28. | Vehicles, Hydras, Cranes, Dumpers and Earth Movers not having automatic back horns linked to gear | 1000 | Per Equipment per day |
| 29. | Not using guide rope while moving material using Hydra or Crane | 1000 | Per event |
| 30. | Violating speed limit during vehicle movement | 1000 | Per event |

| | Nature of Non - Compliance | Penalty in Rs.) | Remarks |
|---|---|---|---|
| **Engineering / Administrative Controls / General** | | | |
| 31. | Major Accident – Victim not reporting for work within 48 hours – resulting in partial loss in earning capacity & termination / demotion in employment | 200000 | |
| 32. | Fatal Accident/Accidents Resulting in total Loss in Earning Capacity # | 500000 | Per victim# |
| 33. | Unsafe Act in violation of standards / clauses of this document | 500-5000 | Per case |
| 34. | Activity carried out without safety work permit where applicable | 2000 | Per person per event |
| 35. | Using untrained / unqualified personnel for hazardous work | 2000 | Per event |
| 36. | Not maintaining proper hygiene in canteen as per BOCW | 1000 | Per event |

**# or as deducted by customer, whichever is higher.**

For repeated **major and** fatal incidents under the same subcontractor for the same package in the same Unit, the subcontractor will pay 2 times the penalty compared to previously paid

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.)

Penalty imposed: _____

1, Rate as per above chart_____

2. No. of Persons/ machine/ event/ labor_____

3. Total Penalty= 1. X 2. =_____

BHEL Personnel:

Signatures:

Name_____

Attachments: Photographs & Documentary proof (if available) for violation

Distribution: 1 Copy: to Sub- contractor Site In-charge,
1 Copy to Site Construction Manager (BHEL)

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Format for Initial Verification of PPE's & Lifting Tools & Tackles** | FORMAT NO: **HSEP:14-F15**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection :** | |

| S. No | Particulars (Serial Number, make, model of PPE, T&P) | Accepted / Rejected | Remarks |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Format for Inspection of Labor Colony** | FORMAT NO: **HSEP:14-F16**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection :** | |

| S. No | Particulars | No | Yes | Comments |
|---|---|---|---|---|
| 1 | Sufficient living space ensured for each occupant with Kitchen area | | | |
| 2 | Area cleanliness ensured through regular cleaning | | | |
| 3 | Toilet facility sufficient for all occupants available, in order with adequate lighting, cleaned regularly and in hygienic condition | | | |
| 4 | Washing facilities available with adequate water supply | | | |
| 5 | Availability of sufficient drinking water in protected tanks with weekly tank cleaning and source tested annually as per IS10500 ensured | | | |
| 6 | Adequate drainage to remove waste and rain water, no flooding | | | |
| 7 | "Unsafe for Drinking" posted near accessible non-potable water and sources; posted in language of occupants or universal symbol | | | |
| 8 | Prevention of mosquitoes, flies, and rodents in immediate housing area through insecticide sprays if required | | | |
| 9 | Electricity provided & electrical connections safety ensured | | | |
| 10 | Fans, Coolers / Quilts, Heaters provided as required to cater to weather conditions along with adequate electricity supply | | | |
| 11 | Houses Walls and roof tight and solid; floors rigid and durable, with smooth, cleanable finish in good repair | | | |
| 12 | Availability of nominal rate ration / common use items shop within / nearby the colony | | | |
| 13 | Emergency medical plan developed:<br>(A) Potential injuries determined<br>(B) Local EMS response determined<br>(C) Qualified first-aid person on site, if required | | | |
| 14 | Emergency plans posted where employees gather | | | |
| 15 | Transportation to nearest suitable facility | | | |
| **Any other checks:** | | | | |
| | | | | |
| **Remarks:** | | **Name & Sign. Of Subcontractor**<br>**HSE Officer** | | |

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Format for Recording of First Aid Injuries** | FORMAT NO: **HSEP:14-F17**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |

**Name of Site:**

**Name of Subcontractor:**

| Date: | Time: | Name of patient: | Subcontractor | Description of injury: | How the injury occurred: | Treatment provided: | First Aider Name: | Initials: | Reportable: Yes/No |
|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|
| | **POWER SECTOR**<br>**Format for Maintaining Records of E-waste Handled / Generated** | FORMAT NO: **HSEP:14-F18**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |

**(Generated Quantity in Metric Tons (MT) per year)**

| | | |
|---|---|---|
| **Site** | | |
| **Subcontractor** | | |
| **Date** | | |
| Types & Quantity of e-waste handled/generated** | Category | Quantity |
| | Item Description | |
| Types & Quantity of e-waste stored | Category | Quantity |
| | Item Description | |
| Types & Quantity of e-waste sent to collection center authorized by producer/dismantler/recycler/refurbisher or authorized dismantler/ recycler or refurbisher ** | Category | Quantity |
| | Item Description | |
| Types & Quantity of e-waste transported* | Category | Quantity |
| | Item Description | |
| Name, address and contact details of the destination | | |
| Types & Quantity of e-waste refurbished* | Category | Quantity |
| | Item Description | |
| Name, address and contact details of the destination of refurbished materials | | |
| Types & Quantity of e-waste dismantled* | Category | Quantity |
| Name, address and contact details of the destination | Item Description | |
| Types & Quantity of e-waste recycled* | Category | Quantity |
| Types & Quantity of materials recovered | Item Description | |
| | Quantity | |
| Name, address and contact details of the destination | | |
| Types & Quantity of e-waste sent to recyclers by dismantlers | Category | Quantity |
| | Item Description | |
| Name, address and contact details of the destination | | |
| Types and Quantity of other waste sent to respective recyclers by dismantlers / recyclers of e-waste | Category | Quantity |
| Name, address and contact details of the destination | Item Description | |
| Types and Quantity of e-waste treated & disposed | Category | Quantity |
| | Item Description | |
| Name, address and contact details of the destination | | |

**Signature of Subcontractor Site In-charge:** **Date**

| | POWER SECTOR | FORMAT NO: **HSEP:14-F19**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |
|---|---|---|
| BHEL | **Format for Maintaining Records of Hazardous Waste at the Facility** | |

1. Name of Site:
2. Name of the Subcontractor:
3. Date:
4. Description of hazardous waste:

| Physical form with description | Chemical form | Total volume and weight (in kg.) |
|---|---|---|
| | | |

5. Description of storage and treatment of hazardous waste:

| Date | Method of storage of hazardous wastes | Date | Method of treatment of hazardous wastes |
|---|---|---|---|
| | | | |

6. Details of transportation of hazardous waste:

| Name & address of consignee of package | Mode of packing/of the waste for transportation | Mode of transportation to site of disposal | Date of transportation |
|---|---|---|---|
| | | | |

7. Details of disposal of hazardous waste:

| Date of disposal | Concentration of hazardous material in the final waste form | Site of disposal (identify the location on the relevant layout drawing for reference) | Method of disposal | Persons involved in disposal |
|---|---|---|---|---|
| | | | | |

8. Data of environmental surveillance:

| Date of measurement | Analysis of ground water | | | Analysis of soil samples | | | Analysis of air sampling | | | Analysis of any other samples (give details) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Location of sampling | Depth of sampling | Data | Location of sampling | Depth of sampling | Data | Location of sampling | Data | | |
| | | | | | | | | | | |

9. Details of the hazardous wastes reused and recycled:

| Date | Total quantity of hazardous waste generated | Details of hazardous waste minimization activity | Material received | Final quantity of waste generated | Net reduction in waste generation quantity and percentage |
|---|---|---|---|---|---|
| | | | | | |

**Signature of Subcontractor Site In-charge:** **Date:**

| | POWER SECTOR | FORMAT NO: **HSEP:14-F20** |
|---|---|---|
| | **HSE Audit / Inspection Checklist-cum-Compliance Report** | REV NO.: 00<br>PAGE NO. 01 OF 3 |

PROJECT:_____ CONTRACTOR:_____

DATE:_____ OWNER :_____

INSPECTION BY:_____

Note : write 'NA' wherever the items is not applicable

| Item | Yes | No | Remarks | Action |
|---|---|---|---|---|
| ***HOUSEKEEPING*** | | | | |
| Waste containers provided and used | | | | |
| Passageways and walkways clear | | | | |
| General neatness of working area | | | | |
| Other | | | | |
| ***PERSONNEL PROTECTIVE EQUIPTMENT*** | | | | |
| Goggles; shields | | | | |
| Face protection | | | | |
| Hearing protection | | | | |
| Respiratory masks etc. | | | | |
| Safety belts | | | | |
| Other | | | | |
| ***EXCAVATIONS / OPENINGS*** | | | | |
| Openings properly covered or barricaded | | | | |
| Excavations shored | | | | |
| Excavations barricaded | | | | |
| Overnight lighting provided | | | | |
| Other | | | | |
| ***WELDING, CUTTING*** | | | | |
| Gas cylinders chained upright | | | | |
| Cable and hoses not obstructing | | | | |
| Fire extinguisher (s) accessible | | | | |
| Others | | | | |
| ***SCAFFOLDING*** | | | | |
| Fully decked platforms | | | | |
| Guard and intermediate rails in place | | | | |
| Toe boards in place | | | | |
| Adequate shoring | | | | |
| Adequate access | | | | |
| Others | | | | |
| ***LADDER*** | | | | |
| Extension side rails 1 m above | | | | |
| Top of landing | | | | |
| Properly secured | | | | |
| Angle + $70^0$ from horizontal | | | | |
| Other | | | | |

| | | | | |
|---|---|---|---|---|
| ***HOISTS, CRANES AND DERRICKS*** | | | | |
| Condition of cables and sheaf OK | | | | |
| Condition of slings, chains, hooks OK | | | | |
| Inspection & maintenance log maintained | | | | |
| Outriggers used | | | | |
| Signals observed and understood | | | | |
| Qualified operators | | | | |
| Others | | | | |
| ***MACHINERY, TOOLS & EQUIPMENT*** | | | | |
| Proper instruction | | | | |
| Safety devices | | | | |
| Proper cords | | | | |
| Inspection and maintenance | | | | |
| Other | | | | |
| ***VEHICLE AND TRAFFIC*** | | | | |
| Rules and regulations observed | | | | |
| Inspection and maintenance | | | | |
| Licensed drivers | | | | |
| Other | | | | |
| ***TEMPORARY FACILITIES*** | | | | |
| Emergency instructions posted | | | | |
| Fire extinguishers provided | | | | |
| Fire-aid equipment available | | | | |
| General neatness | | | | |
| Others | | | | |
| ***FIRE PREVENTION*** | | | | |
| Personnel instructed | | | | |
| Fire extinguishers checked | | | | |
| No smoking in prohibited areas. | | | | |
| Hydrants | | | | |
| Clearance | | | | |
| Others | | | | |
| ***ELECTRICAL*** | | | | |
| Proper wiring | | | | |
| ELCB’s provided | | | | |
| Ground fault circuit interrupters | | | | |
| Protection against damage | | | | |
| Prevention of tripping hazards | | | | |
| Other | | | | |
| ***HANDLING & STORAGE OF MATERIALS*** | | | | |
| Properly stored or stacked | | | | |
| Passageways clear | | | | |
| Other | | | | |
| ***FLAMMABLE GASES AND LIQUIDS*** | | | | |
| Containers clearly identified | | | | |
| Proper storage | | | | |
| Fire extinguisher nearby | | | | |
| Other | | | | |

| | | | | |
|---|---|---|---|---|
| ***WORKING AT HEIGHT*** | | | | |
| Safety nets | | | | |
| Safety belts | | | | |
| Safety helmets | | | | |
| Anchoring of safety belt to the life line rope | | | | |
| ***ENVIRONMENT*** | | | | |
| Lubricant waste/engine oils properly dispose. | | | | |
| Waste from Canteen, offices, sanitation etc. disposed properly. | | | | |
| Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly. | | | | |
| ***HEALTH CHECKS*** | | | | |
| Hygienic conditions at labor camps O.K. | | | | |
| Availability of first-aid facilities | | | | |
| Proper sanitation at site, office & labor camps. | | | | |
| Arrangement of medical facilities. | | | | |
| Measures for dealing with illness. | | | | |
| Availability of potable drinking water for workmen & staff. | | | | |
| Provision of crèches for children. | | | | |

**Signature of Subcontractor Site In-charge:** **Date:**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Format for Inspection of Illumination / Lux Levels** | FORMAT NO: **HSEP:14-F21**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |

| | | | | | |
|---|---|---|---|---|---|
| **Name of Site :** | | | | | |
| **Name of Sub-Contractor :** | | | | | |
| **Inspected by :** | | | | | |
| **Date of Inspection :** | | | | | |
| **Details of Lux Meter Used for Illumination Checking** | | | | | |
| **Serial Number** | | **Last inspection Date** | | **Inspection Due Date** | |

| S. No | Location | Applicable Lux Value | Measured Lux Value | Comments |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| **Any other checks:** | | | | |
| | | | | |
| **Remarks:** | | **Name & Sign. Of Subcontractor HSE Officer** | | |

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Format for Incident Reporting** | FORMAT NO: **HSEP:14-F22**<br>REV NO.: 00<br>PAGE NO. 01 OF 2 |

**Type of incident: Fatal/Major//Fire/Property damage (Tick what is applicable)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | **Name Of Site** | | | 3 | **Activity Area** | | |
| 2 | **Scope Of Work** | | | 4 | **Name Of Contractor** | | |
| | | | | 5 | **NAME & DESIGNATION OF BHEL ACTIVITY I/C** | | |
| 6 | **Date & Time Of Accident** | | | 7 | **Date Resumed** | | |
| 8 | **No. Of Work-Days Lost by Victim (If Duty Not Resumed, Give Estimated Figure)** | | | | | | |
| 9 | **No. Of Man-hours Lost By Others** | | | | | | |
| 10 | **Personal Details Of Injured and/or Details Of Materials/Equipment/ Property Damaged** | | | | | | |
| **Name** | | | | **Name Of Material / Equipment / Property** | | | |
| **Period Of Employment** | | | | | | | |
| **Age** | Yrs. | **Sex** | Male/Female | **Estimated Cost** | **Actual Cost** | | |
| **Marital Status** | | Single/ Married | | | | | |
| **Occupation** | | | | **Nature Of Damage** | | | |
| **Part Of Body Injured** | | | | | | | |
| **Nature Of Injury** | | | | | | | |
| **Agency (Object / Equipment / Substance) Most Responsible For Causing Accident / Injury / Damage** | | | | | | | |
| 12 | **Person (Name & Designation) With Most Control Over Agency (Object / Equipment / Substance) Causing Accident Injury / Damage** | | | | | | |
| 13 | **Describe Clearly How the Accident Occurred (Use Additional Sheet, If Required)** | | | | | | |

| Analysis | | |
|---|---|---|
| **14** | **What Acts and/or Conditions Contributed Most Directly to This Accident** | |
| **15** | **What Are the Basic Reason for The Existence of These Acts and/or Condition?** | |
| **16** | **What Corrective Actions Have Been Taken to Prevent Accident Recurrence?** | |
| | **Date:** | **Signature Of Site HSE Coordinator** |
| **17** | **Comments of Head/Sox** | |
| | **Date:** | **Signature Of Head/SOX** |

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Format for Incident Recording** | FORMAT NO: **HSEP:14-F23**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Name of the Site** | | | | | | | | | |
| **Name of the Subcontractor** | | | | | | | | | |
| **Sl. No.** | **Date & Time** | **Incident Type** (Near Miss /Minor/Major/Fatal/Fire/ Property Damage) | **Incident Location & Details** | **Basic Reason** | **Numbers Injured (Types of Injuries)** | **Sign** | **RCA Done** | **CAPA Details** | **Sign** |
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# SECTION-B

## Special Requirements

(Applicable to this Contract Only)

1. **Establishment of Common Facilities for whole Project –** cost to be borne in full by subcontractor.

**Table 1.1**

| S. No. | Item | Details as per Clause No. of this Section | Applicable / Not Applicable with Remarks | Package |
|---|---|---|---|---|
| 1 | Construction of Medical Centre | a | Applicable | Civil |
| 2 | Construction of Worker Training Centre (A part of safety park) | b | Applicable | Civil |
| 3 | Construction of Vertigo Test Structure (A part of safety park) | c | Applicable | Civil |
| 4 | Deployment of Specialists | d | Applicable | By concerned agencies |
| 5 | HSE Equipment | e | Applicable | By concerned agencies |
| 6 | HSE measurement devices | f | Applicable | By concerned agencies |
| 7 | Urinals in under-construction structures | g | Applicable | By concerned agencies |
| 8 | Safety Park | h | Applicable | Civil |

**a. MEDICAL CENTRE**

i. A medical center shall be setup at site with basic facilities for handling medical emergencies

ii. Deployment of Medical Professional:

1. **A qualified medical professional shall be deployed at site at all times.**
2. **When total employee & worker strength at site crosses 500, medical professional with MBBS Degree from recognized institute shall necessarily be deployed**

iii. Ambulance shall be deployed along with a trained driver and accessories as per Schedule V of BOCW Central Rules, 1998. Ambulance shall be utilized exclusively for transporting the accident victim. Ambulance drivers shall be regularly trained in First Aid.

iv. Non deployment of Ambulance and First Aider as above shall invite a penalty of Rs. 30000 pm and Rs10000 PM respectively

**v.** Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste – Management and Handling Rules, 1998).

vi. Above are bare minimum requirements. Any legal requirements over and above these specifications shall supersede the above requirements

**b. WORKER TRAINING CENTRE**

i. Indoor Worker Training Center to be developed at site with seating capacity of at least 50 trainees

ii. Projector with following minimum specifications:

| | |
|---|---|
| Native Resolution | XGA, 1024x768 |
| Brightness (ANSI lumens) | 3300 |
| Contrast Ratio | 13000:1 |
| Display Color | 30 Bits |
| Aspect Ratio | 4:3 |

iii. A Laptop or Desktop PC with following minimum specifications:

| | |
|---|---|
| Processor | Intel Celeron Dual Core |
| Memory (RAM) | 2 GB |
| Graphics Card | 2GB Video Memory |
| Hard Disk Capacity | 60 GB |
| Monitor Size | 14 inches |
| Keyboard | |
| Mouse | |

iv. Stereo speakers with minimum 50W RMS sound output

v. PA system for Addressing Workers

vi. Seating arrangement

**c. Development of Vertigo Test Structure:**

Vertigo test Structure to be developed as per **Annexure 04**

**d. Specialists:**

Following specialists shall be deployed by the subcontractor, who shall cater to whole project as per BHEL requirements / instructions

I. **Qualified T&P Inspector: subcontractor** shall engage one qualified T&P inspector having undergone a certification course in the discipline.

II. **Qualified Scaffolding Erector and Inspector:** Subcontractor shall deploy one qualified Scaffolding Supervisor and Inspector having undergone a certification course in the discipline

e. **Tools & Equipment:** Following equipment conforming to relevant IS Codes for the job shall be ensured by subcontractor:

| S. No. | Item |
|---|---|
| 1 | Lifelines |
| 2 | Retractable Fall Arrestors |
| 3 | Safety Nets (10m X 5m) |
| 4 | Sky Climbers |
| 5 | Fire Blanket |
| 6 | Honey Bee Removal Suit & Kit |
| 7 | Flashback Arrestors |
| 8 | Barricading Tape |
| 9 | Binoculars |
| 10 | Walkie-Talkies |
| 11 | LOTO kit |
| 12 | 24-Volt light |
| 13 | Sand Buckets |
| 14 | Hard barricading planks |
| 15 | Standby Fire kits |
| | |

| S. No. | Item | Type of Job / Purpose | Remarks |
|---|---|---|---|
| 1 | Lifelines (Steel Rope) and posts | Height work | |
| 2 | Retractable Fall Arrestors | Height Work | |
| 3 | Safety Nets (for fall protection; railings also to be covered) | Height Work | |
| 4 | Sky Climbers | Height Work | |
| 5 | Fire Blanket, Spark/ slag collector | Hot Work | |
| 6 | Honey Bee Removal Suit & Kit | General | |
| 7 | Flashback Arrestors | Hot work | |
| 8 | Barricading –Hard ( Scaffolding Pipes & Clamps or fabricated using structural/round | Height Work, Excavation, General Barricading | |
| 9 | Binoculars | HSE Inspection | |
| 10 | Walkie-Talkies | Lifting | |
| 11 | LOTO kit | Working on charged line | |
| 12 | 24-Volt light | Confined Space/ temp work | |
| 13 | Sand and Water Buckets | Hot work/Electrical work | |
| 15 | Standby Fire kits Fire extinguisher stands | Hot work/Electrical work | |

Above equipment are bare minimum to be essentially maintained at all times. Additional numbers to be deployed as and when required in order to ensure fulfillment of all Safety requirements

**f. HSE Measurement Equipment & Tools**

| S. No | Device |
|---|---|
| 1 | ELCB Tester |
| 2 | Multi meter (Light cables) |
| 3 | Earth Resistance Meter |
| 4 | Lux Meter |
| 5 | Decibel Meter |
| 6 | Anemometer |
| 7 | Breath Analyzer (Alcohol) |
| 8 | Multi-gas analyzer |
| 9 | Gas leakage detector / alarm |
| 10 | Gas monitor (confined space) |
| 11 | Radiation meter & Badges |
| 12 | Blood pressure monitor |
| 13 | Fire detectors |
| 14 | Dust Particle Detector |

**g. Urinals in Under-construction structures:**

Urinals for in under-construction structures for easy access eg. In case of Boiler elevations etc.

2. **Shared Facilities –** where part of operating cost is borne by subcontractor in proportion to contract value

The subcontractor shall bear running expenses of above facilities on a 'proportional to contract value sharing basis as finalized by BHEL.

| S. No. | Facility |
|---|---|
| 1. | Operation of Ambulance, Nurses, Medical Consumables |
| 2. | Construction, Maintenance & Upkeep of Latrines and Urinals in Common spaces |
| 3. | Drinking Water Provision in Common Spaces |
| 4. | Dust Control / Water Sprinkling, Pest Control, Fumigation at Site |

## LIST OF REFERENCES

| S. No | Code Name | Title |
|---|---|---|
| 1 | IS: 818-1888 (Reaffirmed 2003) | Code of Practice for Safety and Health requirements in Electric and Gas Welding and Cutting operations. |
| 2 | IS: 1179-1967 (Reaffirmed 2003) | Specification for Equipment for Eye & Face protection during welding. |
| 3 | IS: 1989 (Part 2):1986 (Reaffirmed 1997) | Specification for Leather Safety Boots & Shoes |
| 4 | IS:2925 – 1984 (Reaffirmed 2010) | Specification for Industrial Safety Helmets |
| 5 | IS:3521: 1999 (Reaffirmed 2002) | Industrial Safety Belts & Harnesses-Specification |
| 6 | IS:3646(Part II) – 1966(Reaffirmed 2003) | Code of Practice for Interior Illumination |
| 7 | IS:3696 (Part I) – 1987 (Reaffirmed 2002) | Safety Code for Scaffolds and Ladders |
| 8 | IS: 3696(Part 2) : 1991 (Reaffirmed 2002 ) | Scaffolds and Ladders-Code of Safety |
| 9 | IS: 3764:1992 | Excavation Work – Code of Safety |
| 10 | IS:3786 – 1983 (Reaffirmed 2002) | Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Accidents |
| 11 | IS.4014.2.1967 | Steel tubular Scaffolding |
| 12 | IS:4770: 1991 (Reaffirmed 2006) | Rubber Gloves Specification (Electricals Purposes) |
| 13 | IS:4912: 1978 (Reaffirmed 2002) | Safety Requirements for Floor and Wall Openings, Railings and Toe Boards |
| 14 | IS: 5557 – 1969 | Industrial and Safety rubber knee boots. |
| 15 | IS: 5983 – 1980 (Reaffirmed 2002) | Specification for Eye-Protectors |
| 16 | IS:6519 – 1971 (Reaffirmed 1997) | Code of Practice for Selection, Care and Repair of Safety Footwear |
| 17 | IS.6549.1972 | Glossary of terms used for Lifting tackles |
| 18 | IS:6994(Part I)-1973 (Re affirmed 1996) | Specification for Industrial Safety Gloves Leather and Cotton Gloves |
| 19 | IS.7215.1974 | Steel Structure Fabrication |
| 20 | IS.7969.1975 | Handling and storage of building material |

| | | |
|---|---|---|
| **21** | IS:8519 – 1977 (Reaffirmed 1983) | Guide for Selection of Industrial Safety Equipment for Body Protection. |
| **22** | IS:8520 – 1977 (Reaffirmed 2002) | Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection. |
| **23** | IS:9167:1979 | Specification for Ear-Protectors |
| **24** | IS:9473:2002 | Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification. |
| **25** | IS: 9944:1992 (Reaffirmed 2003) | Natural and Man-made Fiber Rope Slings- Recommendations on Safe working loads. |
| **26** | IS 11006 : 2011 | Flash Back(Flame) Arrestor Specification |
| **27** | IS: 11226 – 1985 | Leather Safety footwear having direct molding sole. |
| **28** | IS:11057 – 1884 (Reaffirmed 2001) | Specification for Industrial Safety Nets |
| **29** | IS: 12254:1993 (Reaffirmed 2002) | Polyvinyl Chloride (PVC) Industrial Boots Specification |
| **30** | IS:13367(Part 1):1992 (Reaffirmed 20030 | Safe Use of Cranes-Code of Practice |
| **31** | IS: 14166:1994 (Reaffirmed 2002) | Respiratory Protective Devices-Full Face Masks Specification |
| **32** | IS:14746: 1999 (Reaffirmed 2003) | Respiratory Protective Devices-Half Masks and Quarter Masks - Specification |
| **33** | IS: 15397 :2003 (Reaffirmed 2008) | Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification |
| **34** | IS: 19011:2002 | Guidelines for Quality and/or Environmental Management Systems Auditing |

**As per Contract Labor (Regulation & Abolition Act), Central Rules, 1971,**

(1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

**(a) For establishments in which the number of contract laborers employed does not exceed fifty, each first aid box shall contain the following equipment:**

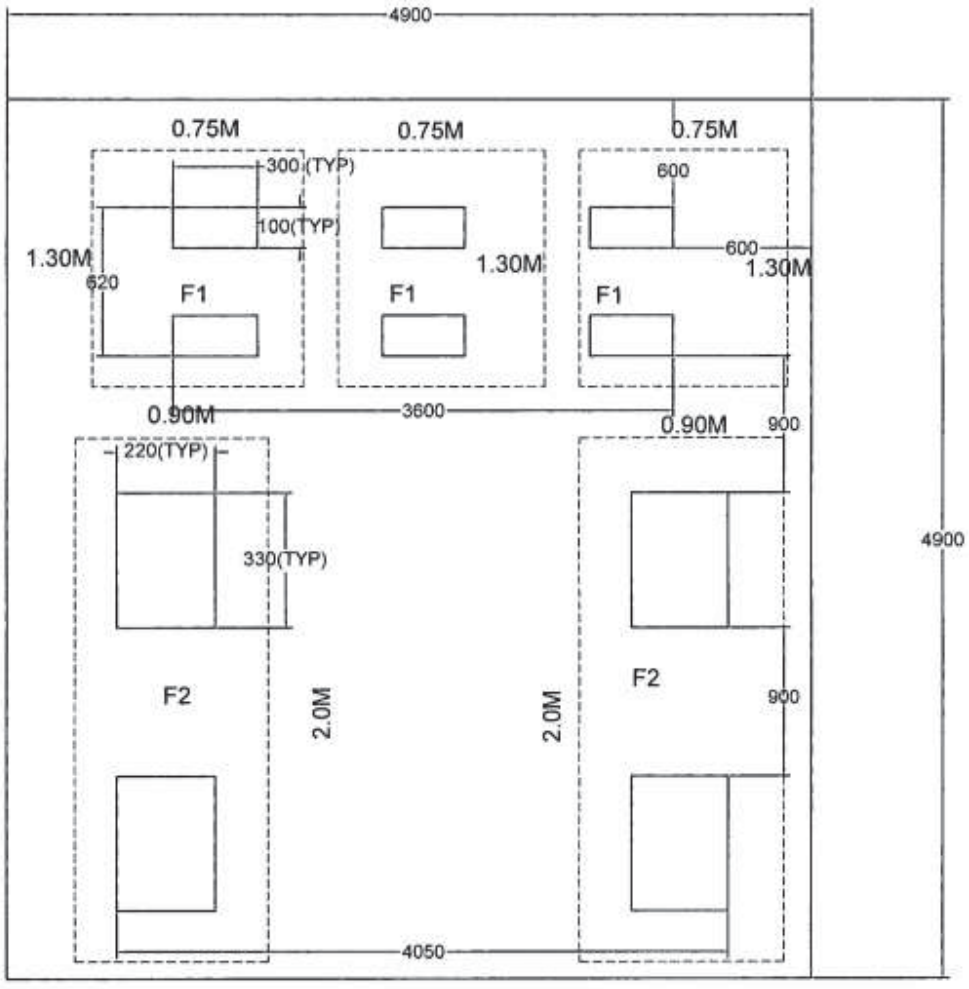
| | |
|---|---|
| (i) | 6 small sterilized dressings |
| (ii) | 3 medium size sterilized dressings |
| (iii) | 3 large size sterilized dressings |
| (iv) | 6 pieces of sterilized eye pads in separate sealed packets. |
| (v) | 6 roller bandages 10 cm wide. |
| (vi) | 6 roller bandages 5 cm wide. |
| (vii) | One tourniquet |
| (viii) | A supply of suitable splints |
| (ix) | Three packets of safety pins. |
| (x) | Kidney tray. |
| (xi) | 3 large sterilized burn dressings. |
| (xii) | 1 (30ml) bottle containing a two percent alcoholic solution of iodine |
| (xiii) | 1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label |
| (xiv) | 1 snake bite lancet |
| (xv) | 1 (30gms) bottle of potassium permanganate crystals. |
| (xvi) | 1 pair scissors |
| (xvii) | 1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labor Institutes, Government of India. |
| (xviii) | A bottle containing 100 tablets (each of 5 grains) of aspirin |
| (xix) | Ointment for burns |
| (xx) | A bottle of suitable surgical anti-septic solution |

**(b) For establishment in which the number of contract laborers exceeds fifty each first-aid box shall contain the following equipment:**

| | |
|---|---|
| (i) | 12 small sterilized dressings |
| (ii) | 6 medium size sterilized dressings |
| (iii) | 6 large size sterilized dressings. |
| (iv) | 6 large size sterilized burn dressings |
| (v) | 6 (15 grams) packets sterilized cotton wool |
| (vi) | 12 pieces of sterilized eye pads in separate sealed packets. |
| (vii) | 12 roller bandages 10 cm wide. |
| (viii) | 12 roller bandages 5 cm wide. |
| (ix) | One tourniquet. |
| (x) | A supply of suitable splints. |
| (xi) | Three packets of safety pins. |
| (xii) | Kidney tray. |
| (xiii) | Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times. |
| (xiv) | 4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops. |
| (xv) | 1 (60ml) bottle containing a two percent alcoholic solution of iodine |
| (xvi) | One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water. |
| (xvii) | 1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label. |
| (xviii) | 1 roll of adhesive plaster (6 cmX1 meter) |
| (xix) | 2 rolls of adhesive plaster (2 cmX1 meter) |
| (xx) | A snake bite lancet. |
| (xxi) | 1 (30 grams) bottle of potassium permanganate crystals. |
| (xxii) | 1 pair scissors |
| (xxiii) | 1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labor Institutes, Government of India. |
| (xxiv) | a bottle containing 100 tablets (each of 5 grains) of aspirin |
| (xxv) | Ointment for burns |
| (xxvi) | A bottle of a suitable surgical anti septic solution. |

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.

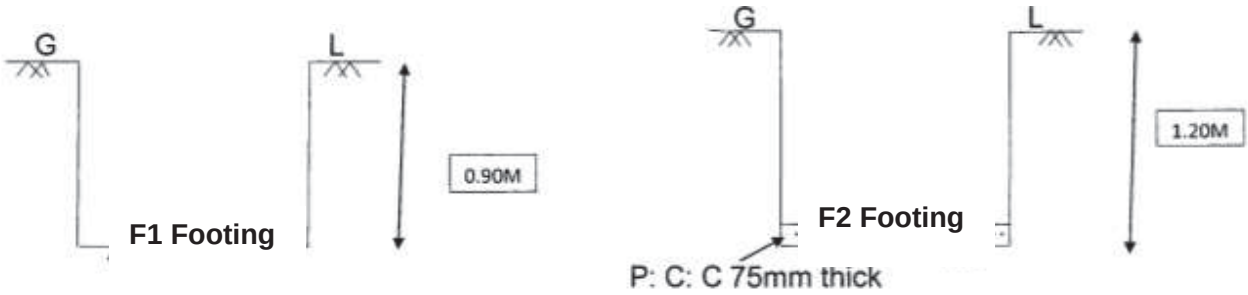
| Table 1 | |
|---|---|
| | |
| **S. No.** | **Topic** |
| **1** | **Vertigo / Height working Test Structure Layout** |
| **2, 3** | **Structure Layout Sketch** |
| **3** | **Actual Photo of a typical structure** |
| **4** | **Bill of Materials** |
| **5** | **Guidelines for Conducting the Test** |




**Note:**

- All dimensions are in mm
- Drawing is not to scale
- Inside boundary area to be filled with sand to level with road (external)
- Details of F1 and F2 are shown below

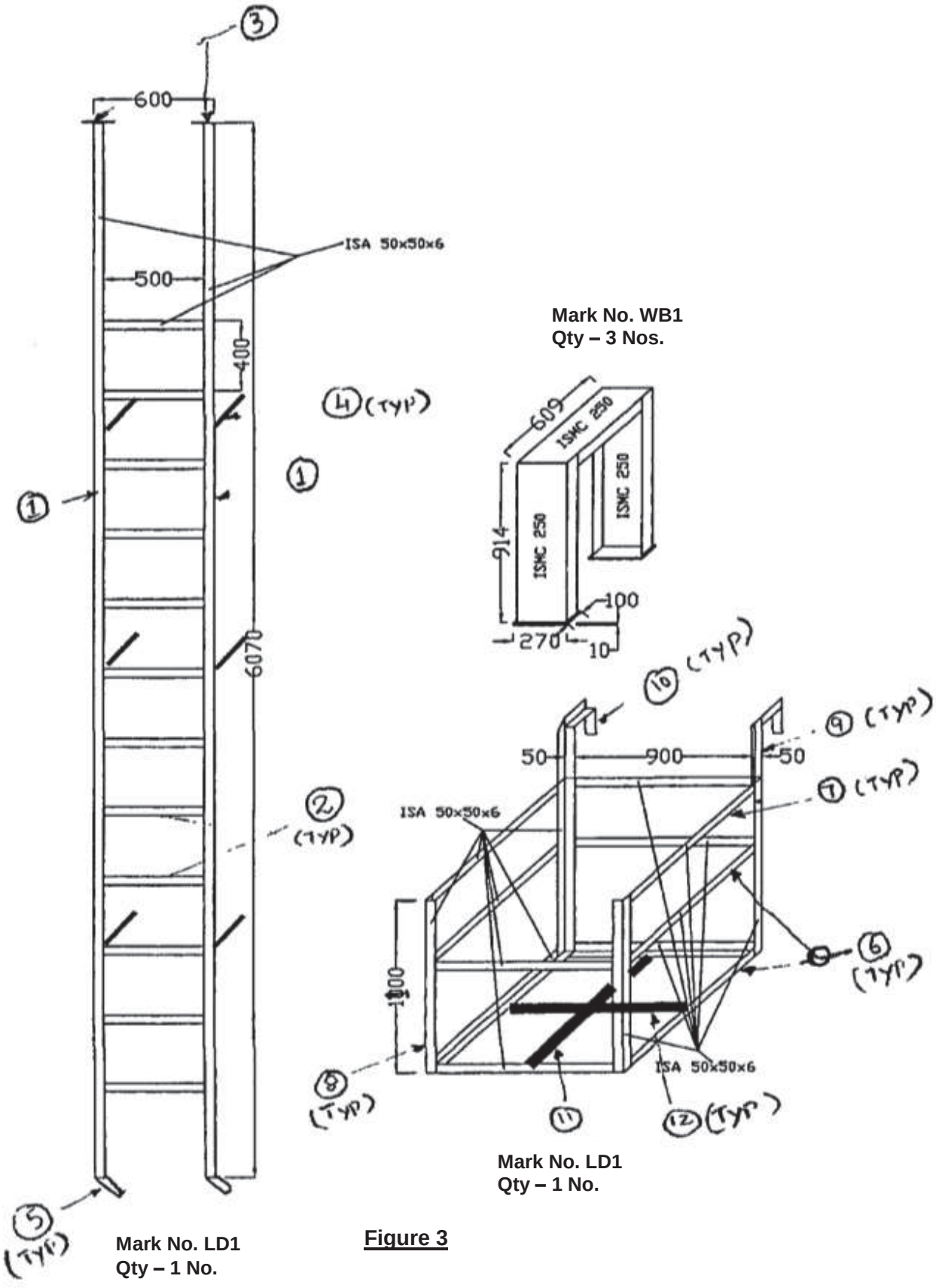
**Figure 1: Vertigo / Height Work Test Structure Layout**




**Note:**

- Concrete Grade is M15
- Drawing is not to scale
- TOC is at Road Level
- G L refers to Ground Level

**Figure 2**




**Mark No. WB1**
**Qty – 3 Nos.**

**Mark No. LD1**
**Qty – 1 No.**

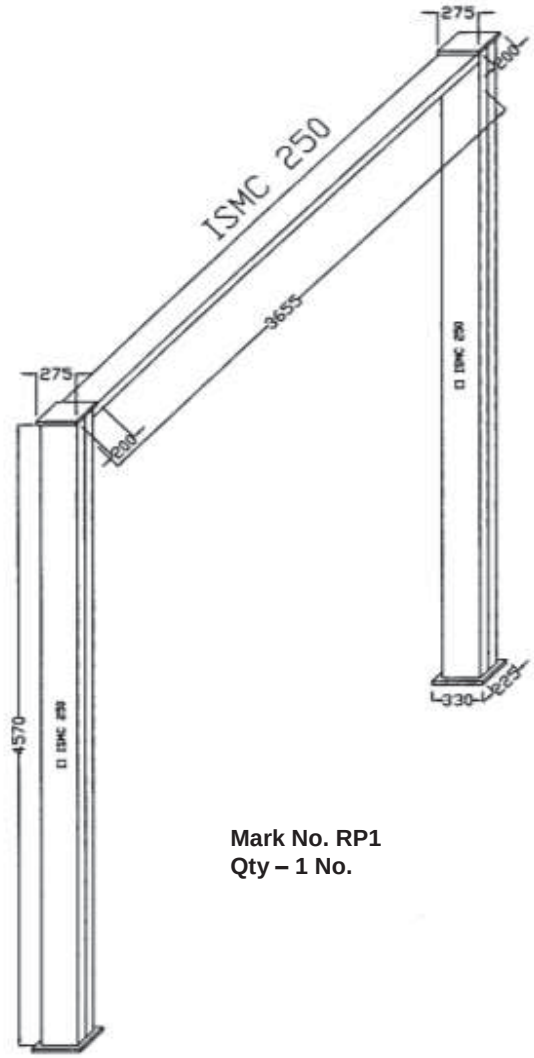
**Mark No. LD1**
**Qty – 1 No.**

**Figure 3**

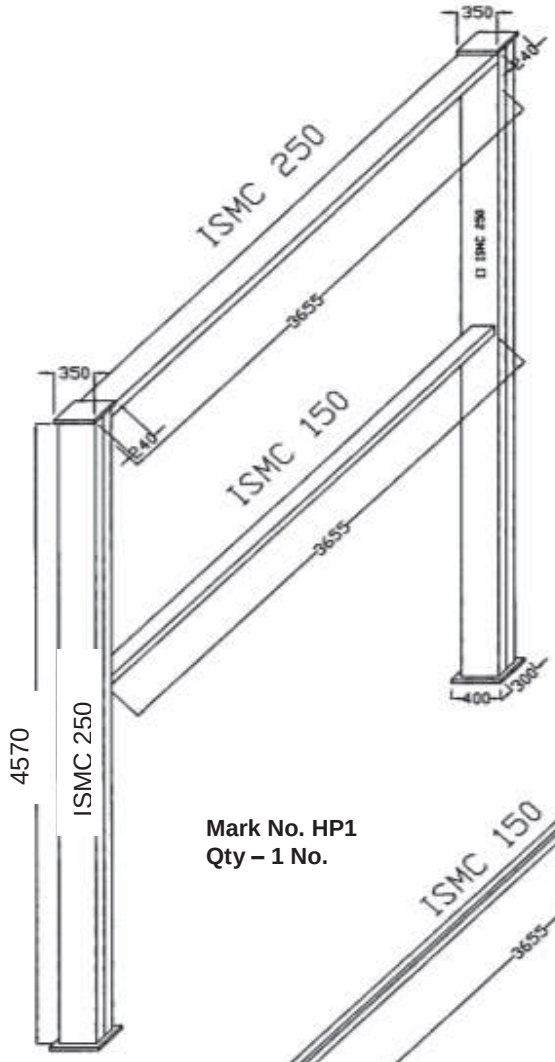
## Vertigo Test Structure Specifications



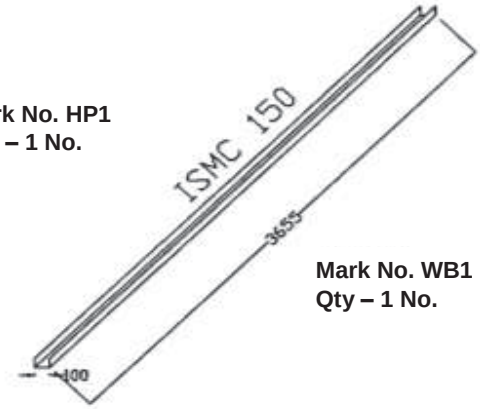
**Figure 4**




**Mark No. RP1**
**Qty – 1 No.**




**Mark No. HP1**
**Qty – 1 No.**




**Mark No. WB1**
**Qty – 1 No.**

**Pic-1:Actual Photo of a Typical Vertigo Test**

| Table 2: BOM FOR HEIGHT WORK INDUCTION TRAINING MODULE | | | | | | |
|---|---|---|---|---|---|---|
| Sl. No. | Description | Width (mm) | Length (mm) | Qty (No's) | Unit Wt (Kgs) | Total Wt. (Kgs) |
| **MKD NO. WB1** | | | | | | |
| 1 | ISMC250 | | 609 | 3 | 34.20 | 62.483 |
| 2 | ISMC250 | | 914 | 6 | 34.20 | 187.553 |
| 3 | ISMC100 | | 3655 | 1 | 9.56 | 34.942 |
| 4 | PL10 | 100 | 270 | 6 | 78.50 | 12.717 |
| | | | **Total Weight (Kgs)** | | | **297.695** |
| **MKD NO. RP1** | | | | | | |
| 1 | ISMC250 | | 4570 | 4 | 34.20 | 625.176 |
| 2 | ISMC250 | | 3655 | 1 | 34.20 | 125.001 |
| 3 | PL25 | 225 | 330 | 2 | 196.25 | 29.143 |
| 4 | PL25 | 200 | 275 | 2 | 196.25 | 21.588 |
| | | | **Total Weight (Kgs)** | | | **800.908** |
| **MKD NO. HP1** | | | | | | |
| 1 | ISMC250 | | 4570 | 4 | 34.20 | 625.176 |
| 2 | ISMC250 | | 3655 | 1 | 34.20 | 125.001 |
| 3 | ISMC150 | | 3655 | 1 | 16.80 | 61.404 |
| 4 | PL25 | 300 | 400 | 2 | 196.25 | 47.100 |
| 5 | PL25 | 240 | 350 | 2 | 196.25 | 32.970 |
| | | | **Total Weight (Kgs)** | | | **891.651** |
| **MKD NO. LD1** | | | | | | |
| 1 | ISA50X50X6 | | 6070 | 2 | 4.50 | 54.630 |
| 2 | ISA50X50X6 | | 500 | 12 | 4.50 | 27.000 |
| 3 | PL12 | 75 | 75 | 2 | 94.20 | 1.060 |
| 4 | ISA50X50X6 | | 300 | 6 | 4.50 | 8.100 |
| 5 | ISA50X50X6 | | 255 | 2 | 4.50 | 2.295 |
| 6 | ISA50X50X6 | | 1000 | 8 | 4.50 | 36.000 |
| 7 | ISA50X50X6 | | 910 | 3 | 4.50 | 12.285 |
| 8 | ISA50X50X6 | | 1100 | 4 | 4.50 | 19.800 |
| 9 | ISA50X50X6 | | 650 | 2 | 4.50 | 5.850 |
| 10 | ISA50X50X6 | | 350 | 2 | 4.50 | 3.150 |
| 11 | PL8 | 75 | 900 | 1 | 62.80 | 4.239 |
| 12 | PL8 | 75 | 410 | 2 | 62.80 | 3.862 |
| | | | **Weight (Kgs)** | | | **178.271** |
| | | | **Total Weight (Kgs)** | | | **2168.525** |

## A. Test Procedure / Guidelines

Fear of height may be physiological or psychological. Therefore, to rule out any possibility of physiological factor, detailed medical check-up of workers is carried out before vertigo test. Medical check-up of workers includes the following:
history of past illnesses (like epilepsy, drug allergy, diabetics/ hypertension, unconsciousness etc.), general physical examination (like height, weight, BMI, build and nourishment etc.), measurement of pulse rate, Blood Pressure, respiratory rate.
After this check-up, those who are found suitable for height work by examining doctor, are allowed to undergo vertigo test.
During this health check-up, psychology of workers is also studied. If any worker finds it extremely difficult/ frightening to climb the monkey ladder & walk on the beam, during/after performing vertigo test or even before performing, then he is treated as disqualified.
As per standard, during vertigo test, worker is allowed to climb on a foundation through monkey ladder, walk on a beam, then steps down at the other end of beam, through monkey ladder. Height of the beam should be at least six feet from ground level. All necessary safety precautions are taken during this test. Worker has to wear full body harness with double lanyard. A horizontal lifeline is run parallel to the beam and worker has to put his lanyards into the lifeline. Additionally, a safety net is also put below the beam for rescue of the victim in case of a fall from beam.
Following activities are generally carried during testing:

1. **Walking Bench Training:**
   a. Person should walk over the channel. He should maintain balance & walk without much problem.
   b. If the person has problem to balances himself on repeated chances, he may be having flat foot or some other problem. So, he may not be fit for height work.
2. **Rope Climb Training:**
   Person should be able to climb the rope up to the top channel for ensuring that in case of fall, a person hanging on the safety harness, will be able to safely climb back to the platform within minimum time period before the safety harness start breaking down under the load.
3. **Height Work Training:**
   Person should walk freely on the middle channel while holding the top channel with the help of safety harness.
4. **Ladder for Vertical fall arrestor Training:**
   Vertical fall arrestor rope is fixed from top to bottom of the ladder. It will ensure:
   - Usage of vertical fall arrestor.
   - Usage of two lanyards of a safety harness.
   - Ensure 3-point contact on the ladder while climb.
5. **Chair for work at height Training:**
   - Climb though vertical ladder with two lanyard ropes.
   - Hooking of two lanyard ropes to life line. With this safe arrangement, he can walk to chair.
   - Sits in the chair safely, comes out & walks back to the vertical ladder & come down from vertical ladder. After completion of vertigo test, blood pressure of worker is again measured. If it is not within acceptable limits for any worker, concerned worker is denied height pass.

   Only those who pass the above training are fit for height work.

**Safety Park Requirements**

| S.No | Training room(capacity 40 persons) | Qty. |
|---|---|---|
| 1 | Class room chair | 25 |
| 2 | Office Table | 3 |
| 3 | Rolling chair | 3 |
| 4 | Almirah | 1 |
| 5 | Visitor chair | 10 |
| 6 | Drawer | 2 |
| 7 | Single bed | 1 |
| 8 | Mattress | 1 |
| 9 | Projector | 1 |
| 10 | Projector screen | 1 |
| 11 | Sound speakers | 1 |
| 12 | Desktop Computer | 3 |
| 13 | Printer | 1 |
| 14 | White Board | 1 |
| 15 | Marker | 5 |
| 16 | Duster | 1 |
| 17 | Door Mat | 9 |
| 18 | Dustbin(Smaal + BIG) | 7+1 |
| 19 | Mannequin | 1 |
| 20 | Helmet | 1 |
| 21 | Face Shield | 1 |
| 22 | Safety Goggle | 1 |
| 23 | Welding sheild | 1 |
| 24 | Ear Muff | 1 |
| 25 | Ear Plug | 1 |
| 26 | Nose Mask | 1 |
| 27 | Breathing Apparatus | 1 |
| 28 | Hand Gloves(Cotton) | 1 |
| 29 | Hand Gloves for Electrician (Rubber) | 1 |
| 30 | Hand gloves Rubber | 1 |
| 31 | Hand Gloves Lather | 1 |
| 32 | Construction Safety Uniform(Boiler Suit) | 1 |
| 33 | Welding Apron | 1 |
| 34 | Safety Shoes | 1 |
| 35 | Leg Guard For Welder | 1 |
| 36 | Poster for Occupational Disease like Pneumoconosis,silicosis etc. | 1 |
| 37 | Gum Boot | 1 |

| | | |
|---|---|---|
| 38 | Full Body Harness | 1 |
| 39 | 8 MM Wire rope for life line. Length 20 Feet(FT). | 1 |
| 40 | Sfety Net for man & materials.Size 15 FT X 15FT. | 1 |
| 41 | MonkEy ladder 15 FT. | 1 |
| 45 | Fire Extingusher All types(DCP,CO2 & Foam) | 1 |
| 46 | Bed Sheet | 1 |
| 47 | Pillow | 1 |
| 48 | Curtain | 12 |
| 49 | curtain fittings | 12 |
| 50 | AC (1.5 TON) | 3 |
| 51 | AC (2 TON) | 2 |
| 52 | Rope pully. | 1 |
| 53 | PP Rope for pully 20 MTR. | |
| 54 | Ladder Clamps | 6 |
| 55 | Allumuniam ladder 6 MTR. | 1 |
| 56 | Carry Bag | |
| 57 | Scaffolding all Materilas for 5 Mtr. Height like.Sacffolding tubes,Sole plate,base plate,Right angle clamps,Swielclamps,beam clamps,Joint box/joint pin,toe guard/board, | |

**Health, Safety & Environment, Power Sector Headquarters**

**Bharat Heavy Electricals Limited**

Regd. Office: BHEL House, Siri Fort, New Delhi – 110049, India

Website: www.bhel.com

**TENDER NO: PSER:SCT:NBN-C2067:20**

**VOLUME -IE**

# FORMS & PROCEDURES

**FOR**

CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.


## BHARAT HEAVY ELECTRICALS LIMITED

**( A GOVT. OF INDIA UNDERTAKING )**
**POWER SECTOR – EASTERN REGION**
**PLOT NO. – 9 / 1, DJ – BLOCK,**
**SECTOR – II, KARUNAMOYEE,**
**SALT LAKE CITY,**
**KOLKATA – 700091.**

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• BANK GUARANTEE FORMATS FOR "RELEASE OF AMOUNTS WITHED/ LIQUIDATED DAMAGES AMOUNT", "SUPPLY FREE ISSUE MATERIAL" & "EARNEST MONEY" IS ALSO GIVEN.

## : will be released later

**Form No: F-01 (Rev 00)**

## OFFER FORWARDING LETTER / TENDER SUBMISSION LETTER

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

---

Offer Reference No:……. Date:……

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : Submission of Offer against Tender Specification No: ……

I/We hereby offer to carry out the work detailed in the Tender Specification issued by Bharat Heavy Electricals Limited, Power Sector-…… ……., in accordance with the terms and conditions thereof.

I/We have carefully perused the following listed doc uments connected with t he above work and agree to abide by the same.

1. Amendments/Clarifications/Corrigenda/Errata/etc issued in respect of the Tender documents by BHEL
2. Notice Inviting Tender (NIT)
3. Price Bid
4. Technical Conditions of Contract
5. Special Conditions of Contract
6. General Conditions of Contract
7. Forms and Procedures

Should our Offer be accepted by BHEL for Award, I/we further agree to furnish 'Security Deposit' for the work as provided for in the Tender Conditions within the stipulated time as may be indicated by BHEL.

I/We further agree to execute all the works referred to in the said Tender documents upon the terms and conditions contained or referred to therein and as detailed in the appendices annexed thereto.

I/We have deposited/depositing herewith the requisite Earnest Money Deposit (EMD) as per details furnished in the Check List.

**Authorised Representative of Bidder**
Signature :
Name :
Address :

Place:
Date:

Form No: F-02 (Rev 00)

## DECLARATION BY AUTHORISED SIGNATORY OF BIDDER

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

---

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration by Authorised Signatory**
Ref : 1) NIT/Tender Specification No: ……,
2) All other pertinent issues till date

I/We, hereby certify that all the information and data furnished by me with regard to the above Tender Specification are true and complete to the best of my knowledge. I have gone through the specifications, conditions, stipulations and all other pertinent issues till date, and agree to comply with the requirements and Intent of the specification.

I further certify that I am authorised to represent on behalf of my Company/Firm for the above mentioned tender and a valid Power of Attorney to this effect is also enclosed.

Yours faithfully,

(Signature, Date & Seal of Authorized Signatory of the Bidder)

Date:

Enclosed : Power of Attorney

Form No: F-03 (Rev 00)

## NO DEVIATION CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

---

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **No Deviation Certificate**
Ref : 1) NIT/Tender Specification No: ……,
2) All other pertinent issues till date

We hereby confirm that we have not changed/ modified/materially altered any of the tender documents as downloaded from the website/ issued by BHEL and in case of such observance at any stage, it shall be treated as null and void.

We also hereby confirm that we have neither set any Terms and Conditions and nor have we taken any deviation from the Tender conditions together with other references applicable for the above referred NIT/Tender Specification.

We further confirm our unqualified acceptance to all Terms and Conditions, unqualified compliance to Tender Conditions, Integrity Pact (if applicable) and acceptance to Reverse Auctioning process.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized representative of the bidder)

Form No: F-04 (Rev 00)

## DECLARATION CONFIRMING KNOWLEDGE ABOUT SITE CONDITIONS

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

---

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration confirming knowledge about Site conditions**
Ref : 1) NIT/Tender Specification No: ……,
2) All other pertinent issues till date

I/We, _____ hereby declare and confirm that we have visited the Pr oject Site as referred in BHEL Tender Specificat ions and acquired full knowledge and information about the Site conditions including Wage structure, Industrial Climate, the Law & Order and other conditions prevalent at and around the Site. We further confirm that the above information is true and correct and we shall not raise any claim of any nature due to lack of knowledge of Site conditions.

I/We, hereby offer to c arry out work as detailed in abov e mentioned Tender Specification, in accordance with Terms & Conditions thereof.

Yours faithfully,

(Signature, Date & Seal of Authorized
Representative of the Bidder)

Date :

Place:

Form No: F-05 (Rev 00)

## DECLARATION FOR RELATION IN BHEL

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder failing which the offer of Bidder is liable to be summarily rejected)

---

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration for relation in BHEL**
Ref : 1) NIT/Tender Specification No: ……,

I/We hereby submit the followi ng information pertaining to relation/relatives of Proprieter/Partner(s)/Director(s) employed in BHEL

**Tick(√) any one as applicable:**

1. The Proprieter, Partner(s), Director(s) of our Company/F irm DO NOT have any relation or relatives employed in BHEL

   OR

2. The Proprieter, Partner(s), or Director(s) of our Company/Firm HAVE relation/relatives employed in BHEL and their particulars are as below:
   (i)

   (ii)

Signature of the Authorised Signatory

Note:

1. Attach separate sheet, if necessary.
2. If BHEL Management comes to know at a later date that the information furnished by the Bidder is false, BHEL reserves the right to take suitable against the Bidder/Contractor.

Form No: F-06 (Rev 00)

NON DISCLOSURE CERTIFICATE
(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

---

*NON DISCLOSURE CERTIFICATE*

I/We understand that BHEL PS __ is committed to Information Security Management System as per their Information Security Policy.

Hence, I/We M/s…….
who are subm itting offer for providing services to BHEL PS __ against Tender Specification No:_____ _____,
hereby undertake to comply with the following in line with Information Security Policy of BHEL PS ___, _____

- To maintain confidentiality of documents & information which shall be used during the execution of the Contract.

- The documents & information shall not be revealed to or shared with third party which shall not be in the business interest of BHEL PS__.

(Signature, date & seal of Authorized Signatory of the bidder)

Date:

Form No: F-07 (Rev 00)

## BANK ACCOUNT DETAILS FOR E-PAYMENT

(To be given on Letter head of the Company /Firm of Bidder, and **ENDORSED (SIGNED & STAMPED) BY THE BANK** to enable BHEL release payments through Electronic Fund Transfer (EFT/RTGS)

---

1. Beneficiary Name :

2. Beneficiary Account No. :

3. Bank Name & Branch :

4. City/Place :

5. 9 digit M ICR Code of Bank Branch :

6. IFSC Code of Bank Branch :

7. Beneficiary E-mail ID :
   (for payment confirmation)

NOTE: In case Bank endorsed certificate regarding above has already been submitted earlier, Kindly submit photocopy of the same

Form No: F-08 (Rev 00)

## FORMAT FOR SEEKING CLARIFICATION

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

---

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Request for Clarification**
Ref : 1) NIT/Tender Specification No: ……,
2) All other pertinent issues till date

| Sl no | Reference clause of Tender Document | Existing provision | Bidder's query | BHEL's clarification |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |

Yours faithfully,

(Signature, date & seal of Authorized Representative of the Bidder)

**Form No: F-09 (Rev 00)**

## CAPACITY EVALUATION OF BIDDERS FOR CURRENT TENDER

| SL NO. | DESCRIPTION OF WORK (Similar to Tendered Scope) | WORK ORDER REF & DATE | CONTRACT VALUE (Rs. LACS) | CUSTOMER NAME & ADDRESS | CURRENT STATUS OF THE JOB ALONG WITH LATEST MILE STONE COMPLETED | %AGE OF WORK COMPLETED | VALUE OF BALANCE WORK (Rs. Lacs) |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |

**NOTES:**

1. BIDDERS ARE REQUIRED TO FURNISH ALL THE JOBS OF SIMILAR NATURE WHICH THEY ARE EXECUTING (IN PROGRESS) AT THE TIME OF SUBMISSION OF TENDER, AS PER ABOVE FORMAT.
2. BIDDERS HEREBY UNDERTAKE THAT THEY HAVE FURNISHED THE DETAILS SOUGHT AS PER POINT NO. 1 IN TOTALITY AND THAT THE DETAILS FURNISHED IS COMPLETE IN ALL RESPECT.
3. BHEL WILL TAKE APPROPRIATE ACTION AS DEEMED FIT , IN CASE, IT IS FOUND AT A LATER DATE THAT THE CONTRACTOR HAD SUPPRESSED THE FACTS AND HAVE NOT FURNISHED THE CORRECT & COMPLETE INFORMATIONS.

Signature

DATE :
PLACE:

Name, Designation & Seal of Bidder

CONTRACT AGREEMENT Form No: F-10 (Rev 00)

---

BHARAT HEAVY ELECTRICALS LIMITED
*(A Government of India Undertaking)*
**Power Sector – ..... Region**

CONTRACT AGREEMENT

**AGREEMENT NO.**_____ _____

| | |
|---|---|
| **NAME OF WORK** | |
| **NAME OF THE CONTRACTOR WITH FULL ADDRESS** | |
| **VALUE OF WORK AWARDED** | |
| **LETTER OF INTENT NO.** | |
| **TIME ALLOTTED FOR COMPLETING THE WORK (DATE OF COMPLETION)** | |

_____ _____

**SIGNATURE OF CONTRACTOR** **(SIGNATURE OF BHEL OFFICER )**

## CONTRACT AGREEMENT

THIS AGREEMENT MADE THIS _____DAY OF_____ between BHARAT HEAVY ELECTRICALS LIMITED (A Government of India Enterprise) a Company incorporated under the Companies Act, 1956, having its Registered Office at BHEL House, Siri Fort New Delhi- 110049 (herein after called BHEL) of the ONE PART.

AND

M/S _____
_____ (hereinafter called the `Contractor') of the SECOND PART.

WHEREAS M/s ----------state that they have acquired and possess extensive experience in the field of ----------

And Whereas in response to an Invitation to Tender No. ---------- issued by BHEL for execution of ---------- the contractor submitted their offer No.----------dated ----------And whereas BHEL has accepted the offer of the Contractor on terms and conditions specified in the Letter of Intent No.---------- ---------- dated ----------read with the references cited therein.

THIS AGREEMENT WITNESSES AND it is hereby agreed by and between the parties as follows:

1. That the contractor shall execute the work of ---------- ----------and more particularly described in Tender Specification No ----------including Drawings and Specifications (hereinafter called the said works) in accordance with and subject to terms and conditions contained in these presents, instructions to Tenderers, General Conditions of Contract, Special Conditions, Annexures, Letter of Intent dated ----------and such other instructions, Drawings, Specifications given to him from time to time by BHEL.

2. The Contractor is required to furnish to BHEL Security deposit in the form of cash/ approved securities/ Bank Guarantee valid upto ---------- for a sum of Rs.---------- towards satisfactory performance and completion of the Contract.

3. The Contractor has furnished a Bank Guarantee bearing no.----------dated ----------for a sum of Rs.----------executed by ---------- ---------- in favour of BHEL towards Security Deposit valid upto ---------

OR

The Contractor has furnished to BHEL an initial Security Deposit of Rs.----------in the form of cash / approved Securities/ B.G No.---------- dated ---------- for Rs.---------- executed by ---------- ---------- in favour of BHEL valid upto --- ---------- and has agreed for recovery of the balance security deposit by BHEL @ 10% of the value of work done from each running bill till the entire Security Deposit is recovered.

OR

The contractor has furnished to BHEL an init ial Security Deposit of Rs.-----(Rs.----------- vide Bank draft No.--- ----------dated ----------and by adjusting EMD of Rs.---------- submitted vide Bank dr aft No.---------- dt.---------) and has agreed for recovery of balance Security Deposit by BHEL @ 10% of the value of work done from each running bill till the entire security deposit is recovered.

4. The Contractor hereby agrees to extend the validity of th e Bank Gua rantee for such further period or periods as may be required by BHEL and if the Contractor fails to obtain such extension(s) from the Bank, th e Contractor, shall pay forthwith or accept reco very of Rs.---------- from the bills in one installment and the contractor further agrees that failure to e xtend the validity of th e Bank Guarantee or failure to p ay the aforesaid amount in the manner specified above shall constitute breach of contract. In addition to above, BHEL shall be entitled to take such action as deemed fi t and prop er for recovering the said sum of Rs.----------

OR

In case the contractor furnishes the bank guarantee at a later date the contractor hereby agrees to extend the validity of bank guarantee for such further period or periods as may be required by BHEL and if the cont ractor fails to obtain such extension(s) from the bank, the contractor shall pay forthwith o r accept recovery of the amount of bank guar antee given in lieu of security deposit from the bill s in one installment and the contractor further agrees that failure to extend the validity of bank guarantee or failure to pay the aforesaid amount in t he manner specified above shall constitute bre ach of contract. In addition to above, BHEL shall be entitled to take such action as deemed fit and pro per for recovering the said sum.

5. That in consideration of the payments to be made to the Contractor by BHEL in accordance with this Agreement the Contractor hereby covenants and undertakes with BHEL that they shall execute, construct, complete the works in conformity, in all respe cts, with the terms and conditions specified in this Agreement and the documents governing the same.

6. That the Contractor sha ll be deemed to have carefully exa mined this Agreement and the documents governing the same an d also to h ave satisfied himself a s to the nature and character of the Works to be executed by him.

7. That t he Contractor shall carr y out and c omplete the execution of the said works to the entire satisfaction of the Engineer or such ot her officer a uthorised by BHEL, wit hin the agreed time schedule, the time of completion being the essence of the Contract.

8. That BHEL shall, after proper scrutiny of the bills submitted by the Contractor, pay to hi m during the progress of the said works such su m as determined by BHEL in accordance with this Agreement.

9. That this Agreement shall be deemed to have come into force from -------- the d ate on which the letter of intent has been issued to the Contractor.

10. That whenever under this contract or otherwise, any sum of money shall be recoverable from or payable by the Contractor, the same may be deducted in the manner as set out in the General Conditions of Contract or other conditions governing this Agreement.

11. That all charges on account of Octroi, Terminal and other taxes including sales tax or other duties on material obtained for execution of the said works shall be borne and paid by the Contractor.

12. That BHEL shall be entitled to deduct from the Contractor's running bills or otherwise Income Tax under Section 194 (C) of the Income Tax Act, 1961.

13. That BHEL shall be further entitled to recover from the running bills of the Contractor or otherwise such sum as may be determined by BHEL from time to time in respect of consumables supplied by BHEL, hire charges for tools and plants issued ( Where applicable) and any other dues owed by the Contractor.

14. That it is hereby agreed by and between the parties that non- exercise, forbearance or omission of any of the powers conferred on BHEL and /or any of its authorities will not in any manner constitute waiver of the conditions hereto contained in these presents and the liability of the Contractor with respect to compensation payable to BHEL or Contractor's obligations shall remain unaffected.

15. It is clearly understood by and between the parties that in the event of any conflict between the Letter of Intent and other documents governing this Agreement, the provisions in the Letter of Intent shall prevail.

16. The following documents

1. Invitation to Tender No----------
   and the documents specified therein.
2. Contractor's Offer No----------
   dated----------.
3. _____
4. _____
5. _____
6. Letter of Intent No_____ dated_____.
7. _____

shall also form part of and govern this Agreement.

IN WITNESS HEREOF, the parties hereto have respectively set their signatures in the presence of

WITNESS (CONTRACTOR)

(to be signed by a person holding
1. a valid Power of Attorney)

2.

WITNESS (For and on behalf of BHEL)

1.

2.

**PROFORMA OF BANK GUARANTEE (in lieu of SECURITY DEPOSIT)**

In consideration of the Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House, Siri Fort, Asiad, New Delhi – 110049 through its Unit at Bharat Heavy Electricals Limited, Power Sector Eastern Region, BHEL Bhawan, Plot No 9/1, DJ Block, Sector-II, Salt lake City, Kolkata – 700091 having agreed to exempt ( Name of the Vendor / Contractor / Supplier) having its registered office at_____ [1] (hereinafter called the said Contractor which term includes supplier), from demand under the terms and conditions of the Contract reference No._____ [2] dated _____[2] valued at Rs……[2] ( Rupees ----------)[2] for <Nature of the Work>[3] (hereinafter called the said Contract) of Security Deposit for the due fulfilment by the said contractor of the terms and conditions contained in the said Contract, on production of a Bank Guarantee for Rs._____ [4] (Rupees _____ only), we ____(indicate the name and address of the Bank) having its Head Office at _____(address of the head Office) (hereinafter referred to as the Bank) at the request of _____ [Name of Contractor(s)] do hereby undertake to pay to the Employer an amount not exceeding Rs._____ in the event of any breach by the said Contractor(s) of any of the terms and conditions contained in the said Contract.

We, _____(indicate the name of the Bank), do hereby undertake to pay the amounts due and payable under this guarantee without any demur, merely on a demand from the Employer. Any such demand made on the bank, shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs._____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor(s) in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this guarantee shall be a valid discharge of our liability for payment hereunder and the Contractor(s) shall have no claim against us for making such payment.

We, further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claim satisfied or discharged or till _____ [5] or till the office/Department/Division of Bharat Heavy Electricals Limited certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said contractor(s) and also including the satisfactory performance of the equipment during guarantee period and accordingly discharges this guarantee. Unless a demand or claim under this guarantee is made on us in writing on or before the _____[6], (3 months more than the present date of validity of Bank Guarantee) we shall be discharged from all the liability under this guarantee thereafter.

We, ____(indicate the name of the Bank)_____further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said Contract and we shall not be relieved from our liability by any reason of any such variation or extension being granted to the said contractor(s) or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

We,……. BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…… [7]

b) This Guarantee shall be valid up to ……[8]

c) Unless the Bank is served a written claim or demand on or before _____[9] (3 months more than the present date of validity of Bank Guarantee) all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, ____(indicate the name of the Bank)____ lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Any claim or dispute arising under the terms of this document shall only be enforced or settled in the courts of at Kolkata only.

Date _____ Day of _____

for____(indicate the name of the Bank)__

(Signature of Authorised signatory)

[1] *NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER .*

[2] *DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE*

[3] *PROJECT/SUPPLY DETAILS*

[4] *BG AMOUNT IN FIGURES AND WORDS*

[5] *VALIDITY DATE*

[6] *DATE OF EXPIRY OF CLAIM PERIOD*

[7] *BG AMOUNT IN FIGURES AND WORDS.*

[8] *VALIDITY DATE*

[9] *DATE OF EXPIRY OF CLAIM PERIOD*

**Note:**

1. **Units are advised that expiry of claim period may be kept 2/3 months after validity date.**
2. **In Case of Bank Guarantees submitted by Foreign Vendors-**
   - **a.** **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
   - **b.** **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**
   - **b.1** In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter-Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

**b.2** **In case, Foreign Vendors intend to provide BG from** Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.

**b.3** The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.

**b.4** The BG should clearly specify that the demand or other document can be presented in electronic form.

**BANK GUARANTEE FOR ADVANCE**

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House, Siri Fort, Asiad, New Delhi – 110049 through its Unit at Bharat Heavy Electricals Limited, Power Sector Eastern Region, BHEL Bhawan, Plot No 9/1, DJ Block, Sector-II, Salt lake City, Kolkata – 700091 having awarded to ( Name of the Vendor / Contractor / Supplier) having its registered office at_____ [1] (hereinafter called "the Contractor" which expression shall include its successors and permitted assigns) a contract Ref No……dated ……[2]valued at Rs……( Rupees ----------) for <Nature of Work> [3](hereinafter called the 'Contract')

AND WHEREAS the Employer has agreed to advance to the Contractor, a sum of Rs…….. (Rupees…….. only), equivalent to _____% of the said value of the Contract (hereinafter called "the said Advance"), upon the condition, that the said Advance shall be secured by undertaking guarantee for Rs ---------- ( Rupees ----------)[4] from a Bank as hereinafter appearing.

We, ……, (hereinafter referred to as the Bank), having registered/Head office at ……. and a branch at …… being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer without any demur, merely on your first demand any sum or sums upto a maximum amount but not exceeding Rs ---------- ( Rupees ----------).

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment hereunder and the Contractors/Supplier shall have no claim against us for making such payment.

We the ……Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We …….. Bank further agree that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Contractor/Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall remain in force upto and including…….. [5] and shall be extended from time to time on the request of the Employer for such period as may be desired by the Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms hereof. However, unless a demand or claim under this Guarantee is made on us in writing on or before the ……[6] (3 months more than the present date of validity of Bank Guarantee) we shall be discharged from all liabilities under this Guarantee.

We, …… BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…… [7]
b) This Guarantee shall be valid up to ……[8]
c) Unless the Bank is served a written claim or demand on or before _____ [9] (3 months more than the present date of validity of Bank Guarantee) all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

Any claim or dispute arising under the terms of this document shall only be enforced or settled in the courts of at Kolkata only.

For and on behalf of
(Name of the Bank)

Date…….
Place of Issue…….

[1] *NAME OF VENDOR /CONTRACTOR / SUPPLIER*

[2] *DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE*

[3] *PROJECT/SUPPLY DETAILS*

[4] *BG AMOUNT IN FIGURES AND WORDS*

[5] *VALIDITY DATE*

[6] *DATE OF EXPIRY OF CLAIM PERIOD*

[7] *BG AMOUNT IN FIGURES AND WORDS*

[8] *VALIDITY DATE*

[9] *DATE OF EXPIRY OF CLAIM PERIOD*

**Note:**

1. **Units are advised that expiry of claim period may be kept 2/3 months after validity date.**

2. **In Case of Bank Guarantees submitted by Foreign Vendors-**

   **a.** **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

   **b.** **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**

   **b.1** In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

   **b.2** **In case, Foreign Vendors intend to provide BG from** Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.

   **b.3** The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.

   **b.4** The BG should clearly specify that the demand or other document can be presented in electronic form.

**Form No: F-13 (Rev 00)**

# FORM for EXTENSION OF VALIDITY OF BANK GUARANTEE

1. **To be typed on non judicial Stamp Papers of value as applicable in the State of India from where the BG has been issued or the State of India where the BG shall be operated**
2. **The non judicial stamp papers shall be purchased in the name of the Party on whose behalf the BG is being issued or the BG issuing Bank**

---

BANK GUARANTEE No: Date:……..

To

(Write Designation and Address of Officer of BHEL inviting the Tender)

Dear Sir

Sub : Validity of Bank Guarantee No:……. Dated ……. for ……. Rs …… in favour of yourself, expiry date ……., on account of M/s …… in respect of Contract Number..……., (herein after called the Original bank Guarantee)

At the request of M/s……., we …….. Bank, having its branch Office at …….. and having Head office at ……, do hereby extend our liability under the above mentioned Bank Guarantee number…….. dated …… for a further period of ……..Months/years from …… to expire on ……..

Except as provided above, all other terms and conditions of the Original Bank Guarantee No ……. Dated…… shall remain unaltered and binding on us.

Kindly treat this extension as an integral part of the original Bank Guarantee to which it would be attached.

Yours faithfully

Signature…….
Name & Designation……..
Power of Attorney/Signing Power No
Seal of Bank

| **Project** | | **Vendor** | | | **Package/Unit** | |
|---|---|---|---|---|---|---|
| **Sl. No.** | **Parameter for Measurement** | **Classification** | **Max Score** | **Score Obtained** | **Measurement Key/Scheduled date** | **Supporting Documents** |
| **#1.01** | Cumulative number of days in the month, the nominated Quality Officer or his authorised nominee was not available | QUALITY | 1.5 | | Quality Officer or his authorised nominee should be available for all the days of working at site | Daily Log Book entry/Incident Registers/letter references |
| **#1.02** | Number of instances of non- compliance wrt FQP, Standard Drawings, Specifications, E&C Manuals etc. | QUALITY | 1.5 | | No deviation from FQP, Standard Drawings, Specifications, E&C Manuals etc. is allowed without BHEL Engineer's approval. | Daily Log Book entry/Incident Registers/letter references |
| **#1.03** | Percentage submission of test certificates for batches of welding electrodes, cement, sand, aggregate, consumable, Paints etc. as applicable for this month OR In case of MM & MH package, monthly checks for Storage/Preservation of material. | QUALITY | 1 | | Submission of 100% Test certificates for materials as per FQP is mandatory. MM & MH package: Storage/Preservation as per manual/procedure. | Daily Log Book entry/Incident Registers/letter references |
| **#1.04** | Number of incidences of improper storage & preservation (not in accordance to the guidelines of BHEL MUs or approved FQP) of materials, consumables (viz. gases, welding electrodes & fluxes, fuel etc.) & bought-out items (paints, fasteners etc.) under the custody of the contractor | QUALITY | 1 | | Total number of non-compliances | Daily Log Book entry/Incident Registers/letter references |
| **#1.05** | Rework/ Rejection instances in a month necessitated due to deviation from Standard Drawings /Specifications /Manuals /E&C procedures /FQPs or due to Poor Workmanship by contractor | QUALITY | 2 | | Reworks/ Rejection should be as minimum as possible. Total number of reworks/ rejections due to reasons attributable to contractor. | Daily Log Book entry/Incident Registers/letter references |
| **#1.06** | Delay in preparation & submission of signed protocols / log sheets / site register / NDT test reports as per approved FQP/ Qualified Welder List along with photocopies of Welder ID cards / Welder Performance Evaluation records etc. in the month OR in case of MM / MH package reconciliation statement / verification report. | QUALITY | 1 | | Within 2 days of measurements taken or within first 3 working days of next month, as advised by BHEL Engineer | Daily Log Book entry/Incident Registers/letter references |
| **#1.07** | Number of instances for Major equipment/product failure due to negligence/improper work/poor workmanship by contractor | QUALITY | 1 | | No such event should happen | Daily Log Book entry/Incident Registers/letter references |
| **#1.08** | Total number of complaints received in the month on the quality of finish / aesthetics | QUALITY | 1 | | Total number of non-compliances | Daily Log Book entry/Incident Registers/letter references |

| **Project** | | **Vendor** | | | **Package/Unit** | |
|---|---|---|---|---|---|---|
| **Sl. No.** | **Parameter for Measurement** | **Classification** | **Max Score** | **Score Obtained** | **Measurement Key/Scheduled date** | **Supporting Documents** |
| **#2.01** | Cumulative number of days of delay in submission of Plan FOR THE MONTH supported by deployment plan of Major T&Ps and Manpower (as per Form F-14) and relevant construction/layout drawings - like A4 plan / elevation views of plan status for structures / pressure parts/Civil Works, Piping isometrics for piping, Layout / PID / System reference sketch, Unloading / storage plans etc.as applicable. | PERFORMANCE | 5 | | Number of days delayed from second working day of the month | Daily Log Book entry/Incident Registers/letter references |
| **#2.02** | Percentage of timely submission of Daily Reports for Progress of work, Resources, Consumables etc. | PERFORMANCE | 1.5 | | Percentage of timely submission of daily reports/ Scheduled date is successive next day for each day | Daily Log Book entry/Incident Registers/letter references |
| **#2.03** | Number of days delayed for submission of FQP log sheets / protocols / Monthly Progress Reports for the work executed during the month under measurement | PERFORMANCE | 1.5 | | Number of days delayed/Scheduled date is first 2 working days of next month | Daily Log Book entry/Incident Registers/letter references |
| **#2.04** | Percentage Shortfall attributable to contractor w.r.t. “Plan - Shortfall attributable to BHEL” for the month as per Form-14 | PERFORMANCE | 35 | | As per Part-A of Form-14 | Progress review formats |
| **#2.05** | Number of days delayed in submission of Running bills with complete supporting documents (including updated reconciliation statement of BHEL issued material) for the month | PERFORMANCE | 2 | | Number of days delayed / Scheduled date is 7th day of next month | Daily Log Book entry/Incident Registers/letter references |
| **#2.06** | Number of times the Top Management of contractor did not respond to critical issues of site, for the month | PERFORMANCE | 1 | | Total number of instances | Daily Log Book entry/Incident Registers/letter references |
| **#2.07** | Cumulative number of days in the month the works were stopped / refused on interpretation of contract clauses/scope due to tendency of taking undue advantage by interpreting contract clauses in their favour | PERFORMANCE | 2 | | Cumulative number of days lost | Daily Log Book entry/Incident Registers/letter references |
| **#2.08** | Number of times rework was refused by contractor | PERFORMANCE | 1 | | Total number of non-compliances | Daily Log Book entry/Incident Registers/letter references |

| **Project** | | **Vendor** | | | **Package/Unit** | |
|---|---|---|---|---|---|---|
| **Sl. No.** | **Parameter for Measurement** | **Classification** | **Max Score** | **Score Obtained** | **Measurement Key/Scheduled date** | **Supporting Documents** |
| **#2.09** | Cumulative number of days in the month recording / logging was not done in daily log / history register / hindrance register / soft form in a PC maintained at BHEL Site Office | PERFORMANCE | 1 | | Cumulative number of days recording or logging was not done / all days of the month | Daily Log Book entry/Incident Registers/letter references |
| **#3.01** | Percentage of Manpower Deployed w.r.t. Plan for the month as per Form-14. | RESOURCES | 7 | | As per Part-B2 of Form-14 | Daily Log Book entry/Incident Registers/letter references |
| **#3.02** | Percentage of T&P Deployed w.r.t. Plan for the month as per Form-14. | RESOURCES | 7 | | As per Part-B1 of Form-14 | Daily Log Book entry/Incident Registers/letter references |
| **#3.03** | Cumulative number of major instances in the month hampering / affecting progress of work due to breakdown or non-availability of major T&P and MME for the work, under the scope of Contractor | RESOURCES | 3 | | Cumulative number of instances | Daily Log Book entry/Incident Registers/letter references |
| **#3.04** | Cumulative number of major instances in the month hampering / affecting progress of work due to non-availability of Consumables/ use of improper consumables under the scope of contractor | RESOURCES | 3 | | Cumulative number of instances | Daily Log Book entry/Incident Registers/letter references |
| **#4.01** | Number of non-compliances during the month for Statutory requirements like validity of Labour Licence, Insurance Policy, Labour Insurance, PF, BOCW Compliance etc. and any other applicable laws/ Regulation, Electrical Licence, T&P fitness certificate, Contractors' All Risk Policy etc. as applicable | SITE INFRASTRUCTURE & SERVICE | 1 | | Total number of non-compliances | Daily Log Book entry/Incident Registers/letter references |
| **#4.02** | Cumulative number of days in a month poor illumination is reported at storage area, erection area, pre-assembly area and other designated areas by BHEL site. | SITE INFRASTRUCTURE & SERVICE | 0.5 | | Total number of non-compliances/random checks | Daily Log Book entry/Incident Registers/letter references |
| **#4.03** | Cumulative number of days of non-availability of well-maintained toilets facilities for workers (separate for men and women) and non-availability of potable drinking water stations for workers in specified areas. | SITE INFRASTRUCTURE & SERVICE | 1 | | Total number of non-compliances/random checks | Daily Log Book entry/Incident Registers/letter references |

| **Project** | | **Vendor** | | | **Package/Unit** | |
|---|---|---|---|---|---|---|
| **Sl. No.** | **Parameter for Measurement** | **Classification** | **Max Score** | **Score Obtained** | **Measurement Key/Scheduled date** | **Supporting Documents** |
| **#4.04** | Total number of instances in the month, Housekeeping NOT attended to in spite of instructions by BHEL -i.e. removal / disposal of surplus earth / debris / scrap / unused / surplus cable drums / other electrical items / surplus steel items / packing materials, thrown out scrap like weld butts, cotton waste etc. from the working area to identified locations | SITE INFRASTRUCTURE & SERVICE | 2 | | Total number of non-compliances/random checks | Daily Log Book entry/Incident Registers/letter references |
| **#4.05** | Total number of instances in a month, Site Office with reasonably good facilities including enough nos. of computers and printers etc. for use by office and supporting staff was not made available/maintained. | SITE INFRASTRUCTURE & SERVICE | 0.5 | | No discrepancy during regular or surprise visits | Photograph and report of the Engineer |
| **#5.01** | Number of days delayed in making labour payments for the last month | SITE FINANCE | 2 | | Number of days delayed / Scheduled date is 7th day of next month | Daily Log Book entry/Incident Registers/letter references |
| **#5.02** | Number of complaints from labour/ sub supplier/ sub-contractor for non-receipt of payments from contractor | SITE FINANCE | 1.5 | | Total number of complaints or reporting | Daily Log Book entry/Incident Registers/letter references |
| **#5.03** | Number of times the site operations were hampered for want of funds at the disposal of site-in-charge. | SITE FINANCE | 1.5 | | Total number of non-compliances | Daily Log Book entry/Incident Registers/letter references |
| **#6.01** | Cumulative number of days in a month the nominated Safety Officer was not available | HSE & SA | 1 | | Safety Officer should be available for all the days | Daily Log Book entry/Incident Registers/letter references |
| **#6.02** | Shortfall in number of weekly safety meetings in the month conducted or attended by the Safety Officer | HSE & SA | 0.5 | | Safety meetings to be held every week | Copy of Minutes of meeting |
| **#6.03** | Level of compliance w.r.t decisions taken in previous Safety meetings | HSE & SA | 0.5 | | Number of consolidated issues discussed in Safety meetings | Copy of Minutes of meeting, Non-compliance intimation documents from BHEL site |
| **#6.04** | Delay in submission of monthly report on safety (including electrical safety for equipment & personnel etc.) in the prescribed form | HSE & SA | 1 | | Number of days delayed/Scheduled date is third working day of next month | Daily Log Book entry/Incident Registers/letter references |
| **#6.05** | Number of days taken for lodging FIRs from date of occurrence/notice of incident of theft / accident etc. | HSE & SA | 0.5 | | Number of days delayed/Scheduled date is within 24 Hrs of occurrence/notice of incidence | Copy of FIR lodged by Contractor |

| **Project** | | **Vendor** | | | **Package/Unit** | |
|---|---|---|---|---|---|---|
| **Sl. No.** | **Parameter for Measurement** | **Classification** | **Max Score** | **Score Obtained** | **Measurement Key/Scheduled date** | **Supporting Documents** |
| **#6.06** | Number of times written(email, letters etc.) warning issued for non-availability/ use of improper Fall protection and rescue arrangement as lifeline, fall arrestors, safety net, hand-railings, covered floors, man-basket, rescue basket & kit etc. by the contractor | HSE & SA | 2 | | Total number of non-compliances | Daily Log Book entry/Incident Registers/letter references |
| **#6.07** | Number of times punitive fines imposed for unsafe practices as per contract like non-availability/use of PPEs as safety shoes, helmets, goggles, gloves, lifeline, safety belts etc. | HSE & SA | 1 | | Total number of non-compliances | Non-compliance intimation documents from BHEL site |
| **#6.08** | Percentage compliance to Emergency preparedness and response plan: Portable Fire-extinguishers, Buckets, Fire-wardens, display of emergency numbers, mock-drills, Hazard Identification and Risk Assessment(HIRA) etc. | HSE & SA | 1 | | Compliance should be 100% as per HSE Plan or as finalized in Safety Meetings | Non-compliance intimation documents from BHEL site |
| **#6.09** | Number of times the agency has defaulted on display of safety posters / safety slogans / safety barriers/emergency numbers etc. in identified areas | HSE & SA | 0.5 | | Total number of instances | Non-compliance intimation documents from BHEL site |
| **#6.10** | Non compliances observed during HSE and Safety Audit | HSE & SA | 0.5 | | Total number of non-compliances | Non-compliance intimation documents from BHEL site, Audit Reports |
| **#6.11** | Cumulative number of days in the month, non-availability of First Aid Kit, First Aider & Emergency Vehicles/Ambulance. | HSE & SA | 0.5 | | Cumulative number of days | Non-compliance intimation documents from BHEL site |
| **#6.12** | Number of days taken for submission of Root Cause analysis (RCA) for the accident from the cut-off date intimated by BHEL for submission of RCA | HSE & SA | 0.5 | | Number of days delayed/Scheduled date is cut-off date intimated by BHEL | Daily Log Book entry/Incident Registers/letter references |
| **#6.13** | Non conductance of training (induction, job specific, height work etc.), tool box meeting and health check-up as per Contract requirements | HSE & SA | 0.5 | | Number of incidences of non-conductance during the month | Daily Log Book entry/Incident Registers/letter references |
| | | **Total** | **100** | | | |

| **Project** | | **Vendor** | | | **Package/Unit** | |
|---|---|---|---|---|---|---|
| **Sl. No.** | **Parameter for Measurement** | **Classification** | **Max Score** | **Score Obtained** | **Measurement Key/Scheduled date** | **Supporting Documents** |
| Less Deduction in Score Due to Major Accidents (Fatal, Permanent Disability or bodily injury by which person injured is prevented to resume to work within 48 hours or more after accident,, Major Damage to Equipment etc.) attributable to the contractor @ 3 points/ accident | | | | | | |
| Less Deduction in Score Due to Minor Accidents attributable to the contractor @ 1 point/ accident | | | | | | |
| Less Deduction in Score Due to not Maintaining of Labour Colony (if applicable) as per BHEL HSE policy @2 points in a month on verification any day | | | | | | |
| | | | | **Final Score** | | |

| **Performance Score Summary for the Month** | **Total Score** | **Score Obtained** |
|---|---|---|
| QUALITY | 10 | |
| PERFORMANCE | 50 | |
| RESOURCES | 20 | |
| SITE INFRASTRUCTURE & SERVICE | 5 | |
| SITE FINANCE | 5 | |
| HSE & SA | 10 | |
| OTHERS (deductions if any) | 0 | |
| **TOTAL** | **100** | |

Note:

1) It is only indicative and shall be as per the online format issued by BHEL time to time.
2) No request will be entertained after specified date of current month w.r.t. changes requested in the scores of immediate previous month.

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Form No: F-19 (Rev 00)

## MILESTONE COMPLETION CERTIFICATE
## (issued by BHEL on the specific request of Contractor)

---

Ref :
Date:

To,

(Name & address of Contractor)

Dear Sir,

References
1. Contract No:
2. Job Description:

This is to hereby confirm that the following Milestone Activity has been achieved in respect of the Contract /Job under reference

| Sl No | Milestone Activity | Remarks |
|---|---|---|
| | | |
| | | |

This certificate is issued as per your request vide letter no …… without any prejudice to the rights of BHEL in line with the terms and conditions of the above referred Contract

Yours faithfully,

For and on behalf of Bharat Heavy Electricals Limited

Construction Manager/Head (Subcontracts)

**Form No: F-20 (Rev 01)**

## CONTRACT COMPLETION CERTIFICATE
## (Issued by BHEL/HQ on the specific request of Contractor)

---

Ref :
Date:

## To Whom so ever it may concern

| | | |
|---|---|---|
| 1 | DESCRIPTION OF WORK | |
| 2 | NAME AND ADDRESS OF THE CONTRACTOR | |
| 3 | CONTRACT NO | |
| 4 | CONTRACT VALUE | |
| 5 | LETTER OF INTENT NO & DATE | |
| 6 | CONTRACT PERIOD//CONTRACT DURATION | |
| 7 | DATE OF START/COMPLETION | |
| 8 | FINAL EXECUTED VALUE | |
| 9 | PERFORMANCE | GOOD<br>SATISFACTORY<br>UNSATISFACTORY |

This certificate is issued as per your request vide letter no …….
without any prejudice to the rights of BHEL to use this certificate for evaluation of your offers for future tenders

Yours faithfully,

For and on behalf of Bharat Heavy Electricals Limited

Head (Subcontracts)

**Form No: F-21 (Rev 00)**

## INDEMNITY BOND

**(To be executed on a Non Judicial Stamp Paper of the requisite value as per Stamp Duty prevalent in the respective State)**

**Thi**s Indemnity Bond executed by <name of company> having their Registered Office at <xxxxxxxxxx> in favour of M/s Bharat Heavy Electricals Limited, a Company incorporated under the Companies Act, 1956, hav ing its R egistered Office at BH EL House, Siri Fort, Asiad, Ne w Delhi - 110049 through its U nit at Power Secto r-_____ Region, ____ _____, _____ State. (Hereinafter referred to as the Company)

And whereas the Company has entered into a Contract with M/s xxxxxxxxx, th e executants of this D eed (hereinafter refe rred to as the Contractor) as it s contractor in respect of the work of "xxxxxxxxxxxxxxxxxxxxxxxxxx".

AND WHEREAS under the provisions of G CC further stipulates that the Contractor shall indemnify the Company against all claims of w hatever nature aris ing during the course of execution of Contract including defects liability period of <xx Months > i.e till <xx xx xxxx>

Now this deed witnes s that in case the Company is made liable by any Authority including Court to pay any claim or compensation etc. in respect of all labour ers or other matters at any stage under or relating to the Contract with the C ontractor , the Contractor hereby covenants and agrees with the C ompany that they shall indemnify and reimburse the Company to the extent of such payments and for any fee, including litigation charges, lawyers' fees, etc, penalty or damages claimed against t he Company by reason of th e Contractor falling to comply with Central/States Laws, Rules etc, or his failure to comply with Contract ( including all expenses and charges incurred by the Company).

The Contractor further indemnifies the Company for the amount which the Company may be liable to pay by way of penalty for not mak ing deductions from the Bills of the Contractor towards such amount and depositing the same in the Government Treasury.

The Contractor further agree that the Company shall be entitled to with hold and adjust the Security Deposit and/or with ho ld and adjust payment of Bills of Contractor per taining to this Contract against any payme nt which the Company has made or is required to mak e for which the Contractor is liab le under the Contract and that such amount can be w ithheld, adjusted by the Company till satisfactory and final settlement of all pending matters and the Contractor hereby gives his consent for the same.

The Contractor further agrees that the terms of indemnity shall s urvive the ter mination or completion of this contract.

The contractor further agrees that the liability of the contractor shall be extended on actual basis notwithstanding the limitations of liability clause, in respect of :

1. breach of terms of contract by the contractor
2. breach of laws by the contractor
3. breach of Intellectual property rights by the contractor
4. breach of confidentiality by the contractor

Nothing contained in this deed, shall be construed as absolving or limiting the liability of the Contractor under said Contract between the Company and the Contractor . That this Indemnity Bond is irrevocable and the condition of the bond is that the Contractor shall duly and punctually c omply with the terms and the conditions of this deed and contractu al provisions to the satisfaction of the Company.

In witness where of M/s xxxxxxxxxxxxx these presents on the day, month and year first, above written at xxxxxxxx by the hand of its signatory Mr. xxxxxxxxxx.

Signed for and on behalf of
M/s xxxxxxxxxxxxxx

Witness:
1
2

Form No: F-22 (Rev 00)

## CONSORTIUM AGREEMENT

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(To be executed on Rs. 50/- Non – Judicial Stamp Paper)

THIS AGREEMENT is made and executed on this _____ day of _____, by and between (1) M/s _____ , ( The First Party, i.e, the Bidder) a company incorporated under the Company's Act 1956, having its registered office at _____ _____(herein after called the "Bidder", which expression shall incl ude its' successors, administrators, executors and permitted assigns) and (2) M/s _____ _____, (The Second Party, i.e, the associates ), a company incorporated under th e Company's Act 1956, having its registered office at _____ (herein after called the " Associates", whic h expression shall include its' successors, administrators, executors and permitted assigns).

WHEAEAS the Owner, Bharat Heavy Electr icals Ltd, a Government of India Undertaking, proposes to issue / issued an NIT (herein after referred to as the said NIT) inviting bids from t he individual Bidders for undertaking the work of _____, at _____ (herein after referred to as the said works).

WHEREAS the said NIT enables submis sion of a bid by a Consortium subject to fulfillment of the stipulations specified in the said NIT.

AND WHEREAS M/s _____ _____ ( The F irst Party, i.e, the Bidder) will submit its proposal in response to the aforesaid invitation to bid by the Owner for _____ as detailed in the Bid doc. no. < TENDER REF-------->

AND WHEREAS M/s _____ _____ (The First Party, i.e the Bidder) itself is meeting all the qualifying requirements except the qualifying requirements of _____ _____ (as detailed in the NIT) and in order to fully meet the qualifying requirements of NIT, this tie-up agreement is being entered into with M/s _____ (The Second Party, the Associates), who fully meet the balance part of the said works (_____).

WHEREAS the First Party and the Second Party are contractors engaged in the business of carrying out various items of works. WHEREAS the two parties have agreed to constitute themselves into a consortium for the purpose of carrying out the said works, and that the consortium will be continued till the completion of the works in all respects.

WHEREAS the parties have agreed to certain terms and conditions in this regard:

NOW THEREFORE THIS AGREEMENT WITNESSETH AS FOLLOWS :

1. First and Second parties hereby constitute themselves into a Consortium for the purpose of bidding and undertaking the said works pursuant to the said NIT as hereinafter stated.

2. The First Party will be the leader (Lead Partner) and will be responsible for the entire works.

**CONSORTIUM AGREEMENT**

3. The First Party shall undertake the following part(s) of work detailed in the NIT namely

_____
_____
__

4. The Second Party shall undertak e the following part(s) o f work detailed in the said NIT namely

_____
_____
__

5. The parties hereby d eclare and confirm that each of them will fulfill the required minimum qualifying requi rements as prescribed in the said NIT for the wor ks agreed to be undertaken by them as stated here-in-above.

6. It is also agreed between the parties hereto that all of them shall be individually and severally responsibl e for the completion of the said works as per the schedule. Further, if the Employ er/Owner sustains any loss or damage on a ccount of any breac h of the C ontracts, we the, Consortium partners individually and severally undertake to promptly indemnify and pay such losse s / damages caused to the Employer/Owner on it s written dem and with out any demur , reservation, contest or protest in any manner whatsoever.

7. The parties hereby agree and under take that they shall provide adequate finances, suitable Tools, Plan ts, Tractors, Trailers, other transportation equipment, other Tools & Plant s, Measuring & Monitoring Equipments (MME s), Men and Machinery etc. for the proper and effective execution of the works to be undertaken by them as specified here-in-above.

8. It is agreed interse between t he parties hereto that all the consequences liabilities etc., arising out of any default in the due execution of the said works shall be borne by the party in default, that is by party in whose area of works default has occurred, provided however, so far as M/s Bharat Hea vy Electricals Limited is concer ned, all the parties shall be liable jointly and severally.

IN WITNESS HEREOF the parties above named have signed this agreement on the day month and year first above written at _____(Place) .

WITNESS For

1. NAME (FIRST PARTY)

2. OFFICIAL ADDRESS

WITNESS For

1. NAME (SECOND PARTY)

2. OFFICIAL ADDRESS

[The successful bidder shall have to execute the " JOINT DEED OF UNDERTAKING " in the format to be made available by BHEL at the time of awarding].

**Form No: F-23 (Rev 00)**

## REFUND OF SECURITY DEPOSIT

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To,
The Construction Manager
BHEL Site Office
---
Dear Sir,

Sub : **Refund of Security Deposit**
Ref : Contract No: ……,
Work:……..
I/We have submitted Final Bill in respect of the above Contract/Work vide our letter no:…… dated …….. . In line wit h Tender c onditions (GCC clause no 1.11), kindly arrange to release/refund the Security Deposit along with Final Bill payments.

The details of Security Deposit are as below:

1. Cash Portion :
2. BG Portion :

Thanking You

Date: _____ Authorised representative of Contractor

==========

**To be filled up by BHEL**

1. Security Deposit to be refunded:
    a. Cash Portion:
    b. BG Portion :
2. Less
    a. Amount spent by BHEL on behalf of Contractor:
    b. Payments made by BHEL on behalf of Contractor:
    c. Other recoveries for Services etc
    d. Any other recoveries
    e. Total of 'a' to 'd':
3. Net Amount to be released (1-2) :
4. Certified that
    a. The payment recommended for release is in order and there are no demands other than those included in the claim outstanding from the Contractor
    b. Contract Guarantee period of ……. Months commenced wef :_____
    c. All objections raised so far have been settled
    d. A note for refund of Security Deposit has been made in the Measurement Book

Signature of BHEL Engineer

Construction Manager

Date:----------

**Form No: F-24 (Rev 00)**

## REFUND OF GUARANTEE MONEY

**BHARAT HEAVY ELECTRICALS LIMITED**
**POWER SECTOR, _____ REGION**

Ref No: Date:

1. Name and Address of Contractor :
2. Contract Agreement/LOI No :
3. Date of Contract Agreement/LOI :
4. Name of the Work undertaken :
5. Date of commencement of the Work :
6. Date of Completion of the Work :
7. Period of Maintenance (Guarantee Period) :
8. Date on which the Final Bill was paid :
9. Last date of making good the defect during Maintenance Period :
10. Expenditure incurred by BHEL during Maintenance Period, if any, recoverable :
11. Date on which Guarantee Money refund: falls due as per Contract
12. Amount of Guarantee Money to be refunded:
13. Less Amounts recoverable (with details)
    a. Amount spent by BHEL on maintenance :
    b. Payments made by BHEL on behalf of Contractor:
    c. Court dues/penalties/compensation :
    d. Other recoveries for Services, etc :
    e. Total of 'a' to 'd' :
14. Net Amount recommended for release (12-13) :

Signature of BHEL Engineer

Date: _____

**CERTIFICATE TO BE FURNISHED BY THE CONTRACTOR**

I/We have no claim or demand outstanding against BHEL_____, for the work done or for labour or material supplied or any other account arising out of or connected with the Contract Agreement/LOI (No_____ dated _____) and the payment of this bill shall be in full and final settlement of all my/our claims and demands including the 'Deposits' of the Contract Agreement/LOI referred to.

Signature of Contractor

Date:

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**CERTIFICATE TO BE FURNISHED BY SENIOR ENGINEER/CONSTRUCTION MANAGER**

1. Certified that
   a. The payment recommended for release is in order and there are no demands other than those included in the claim outstanding from the Contractor
   b. Maintenance period (Contract Guarantee period) is over and the Contractor has carried out the works required to be carried out by him during the period of maintenanc e (Guarantee) to our satisfaction, and all expens es incurred by the Company on carrying out such works have been included for adjustment
   c. All objections raised so far have been settled
   d. A note for refund of Guarantee Amount has been made in the Meas urement Book and Contract Agreement/Work Order

Signature of BHEL Engineer

Construction Manager

Date:----------

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**FOR USE IN ACCOUNTS DEPARTMENT**

Passed for Rs_____ ( Rupees _____ only)

Accountant Accounts Officer

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**ACKNOWLEDGE BY THE CONTRACTOR**

Received Rs _____ in full and final settlement of my/our claim

Signature of Contractor

Date:

**Form No: F-25 (Rev 00)**

# POWER OF ATTORNEY for SUBMISSION OF TENDER/SIGNING CONTRACT AGREEMENT

**(To be typed on non judicial Stamp Papers of appropriate value as applicable and Notarised)**

KNOW ALL MEN BY THESE PRESENTS, that I/We do hereby make, nominate, constitute and appoint Mr …… …….. , whose signature given below herewith to be true and lawful Attorney of M/s…… hereinafter called 'Company', for submitting Tender/entering into Contract and inter alia, sign, execute all papers and to do necessary lawful acts on behalf of Company with M/s Bharat Heavy Electricals Ltd, Power Sector _____ Region, _____, in connection with …… …… …… vide Tender Specification No : _____, dated _____.

And the Company do hereby agree to ratify and confirm all acts, deeds, things or proceedings as may be lawfully done by the said attorney and by or on behalf of the company and in the name of the company, by virtue of the powers conferred herein and the same shall be binding on the company and shall have full force and effect.

IN WITNESS WHEREOF the common seal of the company has been hereunto affixed in the manner hereinafter appearing on the document.

Dated at _____, this _____ day of _____

Director/CMD/Partner/Proprietor

Signature of Mr……(Attorney)

Attested by: Director/CMD/Partner/Proprietor

Witness

Notary Public

**Form No: F-26 (Rev 00)**

## ANALYSIS OF UNIT RATES QUOTED

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

Offer Reference No:……  Date:……

To,
(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : Analysis of Unit Rates Quoted
Ref : Tender Specification No: ……

Analysis of Unit Rates quoted by us in respect of above Tender is as detailed

| SN | DESCRIPTION | % OF QUOTED RATE | REMARKS |
|---|---|---|---|
| 01 | SITE FACILITIES VIZ., ELECTRICITY, WATER OTHER INFRASTRUCTURE. | | |
| 02 | SALARY AND WAGES + RETRENCHMENT BENEFITS | | |
| 03 | CONSUMABLES | | |
| 04 | T&P DEPRECIATION & MAINTENANCE | | |
| 05 | ESTABLISHMENT & ADMINISTRATIVE EXPENSES | | |
| 06 | OVERHEADS | | |
| 07 | PROFIT | | |
| | **TOTAL** | 100% | |

Yours faithfully,

(Signature, Date & Seal of Authorized Representative of the Bidder)

**Form WAM 6**

**BHARAT HEAVY ELECTRICALS LIMITED**
**DIVISION**.....
**Running Account Bill**
(Para 4.31.1 of Works Accounts Manual)

Name of the Contractor: Departmental Bill no: Date:
Name of the Work: Division: Sub-Division:
Sanctioned Estimate: Date of written order to commence the work :
Code No: Date of commencement of the Work:
Contract Agreement No : Dated: Due date of completion as per Agreement:

**1. ACCOUNT OF WORK EXECUTED**

| On account payment for work not previously previously measured** | | | Item No of | Description of Work | Quantity as per agree-ment | Quantity executed up to date | Rate | Unit | Payment on the basis of actual measure-ment up to date | Quantity since last running account bill | Payment on the basis of actual measurement since last running account bill | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total As per Running Account bill | since last running account bill | Total up to date | | | | | | | | | | | |
| Rs. | Rs. | Rs. | | | | | Rs. | P. | Rs. | P. | Rs. | P. | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | 13 |

* *1. Whenever payment is made on 'on account' basis without actual measurements the amount in whole rupees should be entered in columns 1 to 3 only and not in columns 7 to 12.
2. whenever there is an entry in column 12 on the basis of actual measurement, the whole of the amount previously paid without detailed measurement should be adjusted by a minus entry in column 2 equivalent to the amount shown in column 1, so that the total up to date in column 4 may become nil.

**Form WAM 6 (contd…)**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | |
|---|---|---|
| Running Account Bill | Total value of work done up to date | (A) … |
| | Deduct value of work shown on the last | (B) … |
| | Net value of work done since last | (C) … |

Rupees (in words)
……only.

**Form WAM 6 (contd…)**

## II.MEMORANDUM OF PAYMENTS

| | | Rs. P. | I Rs. P. | II Rs. P. |
|---|---|---|---|---|
| 1.Total value of work actually measured as per Account No. I. Column 10 | (A) | …… | | …… |
| 2.Total up to date 'on account' payment for work covered by approximate Or plan measurements as per Account No. I, Column 3 | (B) | …… | | …… |
| 3.Total up to date secured advances on security of materials as per column 8 Of the enclosed Account (Form WAM 10) | (C) | …… | | …… |
| 4.Total up to date payments [(A) + (B) + (C)] | (D) | …… | | …… |
| 5.Total amount of payments already made as per Entry (D) of last Running Account Bill No…….. Dated……..forwarde to the Accounts Office on ……. | (E) | | | |
| 6.Balance [(D)-(E)] | | …….…… | | |
| 7.Payments now to be made: | | | | |
| a) by cash/cheque | | | …… | |
| b) by deduction for value of materials supplied | | | | |
| c) by BHEL vide Annexure A attached | | | …… | |
| d) by deduction for hire of tools and plant vide | | | | |

Annexure B attached ……

e) by deduction for other charges vide Annexure C

Attached ……

f)by deduction on account of security deposit ……

h) by deduction on account of Income Tax …… ……

Note: Amounts relating to items 4 to 6 above should be entere in column II and those relating to item 7 in column I. The amount shownagainst item 6 and the total of item 7 should agree with each other.

**III.CERTIFICATE OF THE ENGINEER IN CHARGE** **Form WAM 6 (contd…)**

1. The measurements on which the entries in column 7 to 12 of Part I of this Bill (Account of work executed) are based were made by……and are recorded at pages……..of
(Name and Designation)

Measurement Book No ……..

2. Certified that the methods of measurement are correct and the work has been carried out in accordance with the terms and conditions, schedules, specifications and drawings etc, forming part of the contract agreement, subject to deviations included in the deviation statement (Annexure D).
3. Certified that in addition to and quite apart from the quantities of work actually executed as shown in column 10 of Part I, some work has actually been done in connection with several items and the value of the such work is, in no case, less than 'on account' payments as per column 3 of Part I, made or proposed to be made, for the convenience of the contractor in anticipation of, and subject to the results of, detailed measurement which will be made as soon as possible.

Signature of Contractor Signature of Engineer in charge

Date: Designation:

Date:

## IV. CERTIFICATE OF THE SENIOR ENGINEER

1. Certified that measurements have been check measured to the prescribed extent by ……... ……at site and also by the undersigned and the relevant entries have been intialled in the Measurement book. (vide pages……)
(Name and Designation)
2. Certified that all the measurements recorded in the measurement book have been correctly billed for
3. Certified that all recoberable amounts in respect of materials tools and plant etc, and other charges have been correctly made vide Annexures A to C attached.

Certified for payment * of Rs…….( Rupees…….only)
To be paid in cash/by cheque in the presence of …….

ALLOCATION

The expenditure is chargeable as under and to be included in the accounts for……20……

| Ledger Head | Debit (Gross amount) Rs. P. | Credit (Deductions) Rs. P. |
|---|---|---|
| _____ | _____ | _____ |
| Total | _____ | _____ |
| | _____ | _____ |

* Here specify the net amount payable.

Signature of Senior Engineer
Date:

**Form WAM 6 (contd…)**

## V.ENTRIES TO BE MADE IN THE ACCOUNTS OFFICE

Accounts Bill No ……Dated……..
Entered in Journal Book vide entry No…….Dated…….
Passed for……Rs……
Less Deductions……..Rs……
Net Amount Payable……Rs……...
(Rupees…….only)
Payable to Shri/M/s……by cheque/cash
Entered in Contractor's Ledger No……Page……..

ALLOCATION

Estimate No: Code no:
Name of the Work:

| Ledger Head | Debit (Gross amount) Rs. P. | Credit (Deductions) Rs. P. |
|---|---|---|
| _ _ _ _ _ _ _ _ | _ _ _ _ _ _ _ _ | _ _ _ _ _ _ _ _ _ _ |
| | _ _ _ _ _ _ _ _ | _ _ _ _ _ _ _ _ _ _ |

Total _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Assistant Accountant Account Officer
Date: Date: Date:

VI. Received Rs.....( Rupees.....only) as per Memorandum of Payments on account of this work.

Signature of witness Revenue
Address :

Stamp
Signature of Contractor
Date: Date:

**VII. ENTRIES TO BE MADE BY TREASURY SECTION**

Cash Book entry No. and date: Amount paid Rs.....

Amount unpaid Rs.....

Total Rs.....

Signature of Cashier
Date:

**Form WAM 6 (contd...)**

**ANNEXURE A**

Statement showing details of materials issued to the contractor Shri/M/s……

In respect of Contract Agreement No ……..Dated……

| Sl. No. | Stores issue Voucher No. and date | Issue voucher No. and date allotted by stores to the SIV | Description of material issued to the contractor | Quantity issued | Quantity actually incorp-rated in the work | Whether recover-able from the contrac-tor or supplied free | If recoverable from the contractor | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Rate at which recover-able | Amount recover-able | Amount recover-ed up to previous bill | Balance now recover-ed | |
| | | | | | | | Rs. P. | Rs. P. | Rs. P. | Rs. P. | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | | | Total | | | | | | | | |

Signature of contractor — Signature of Engineer in Charge — Signature of Senior Engineer

Date: — Date: — Date:

**Form WAM 6 (contd…)**

**ANNEXURE B**

Statement showing tools and plant issued to the contractor Shri/M/s……

In respect of Contract Agreement No ……..Dated……

| Sl. No | Description of tools and plant issued | Period for which Issued | Rate at which recovery Is to be Made Rs. P. | Amount recover-able Rs. P. | Amount recovered upto previous bill Rs. P. | Balance now recovered Rs. P. | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | Total | | |

Signature of contractor — Signature of Engineer in Charge — Signature of Senior Engineer

Date: — Date: — Date:

**Form WAM 6 (contd…)**

**ANNEXURE C**

Statement showing details of other recoveries to be made from the contractor Shri/M/s……..……

In respect of Contract Agreement No ……..Dated……

| Sl. No | Particulars | Unit | Quantity | Rate | Amount recover-able | Amount recovered upto pre-vious bill | Amount now recovered | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Rs. P. | Rs. P. | Rs. P. | Rs. P. | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. | | | | Water Charges | | | | |
| 2. | | | | Electricity charges | | | | |
| 3. | | | | Seignorage charges | | | | |
| 4. | | | | Medical charges | | | | |
| 5. | | | | Cost of empty gunny bags and Empty containers not returned | | | | |
| 6. | | | | | | | | |
| 7. | | | | | | | | |
| 8. | | | | | | | | |
| 9. | | | | | | | | |

10.

Total

Signature of contractor | Signature of Engineer in Charge | Signature of Senior Engineer

Date: | Date: | Date:

**Form WAM 6 (contd…)**

**ANNEXURE D**

Name of the Contractor: Contract Agreement No:
Name of the Work: Date:

| Sl. No. | Description of item | Unit | Quantity as per Agreement | Quantity as executed | Quantity further anticipated | Total quantity anticipated on completion | Rate as per agreement Rs. P. |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

| Rate as the executed with any Rs. P. | Amount as per agreement Rs. P. | Amount as executed Rs. P. | Amount further anticipated Rs. P. | Total amount anticipated on completion Rs. P. | Difference _ _ _ _ _ _ _ _ _ _ _ Excess Rs. P. | savings Rs. P. | Reason for deviation authority, if |
|---|---|---|---|---|---|---|---|
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Signature of Engineer in Charge
Date:

Signature of Senior Engineer
Date:

BHARAT HEAVY ELECTRICALS LIMITED
DIVISION……
……And Final bill
(Para 4.3.2 Of Works Accounts Manual)

| | | | | | |
|---|---|---|---|---|---|
| Name of Contractor | | Departmental Bill no | | Date | |
| Name of the Work | | Division | | Division | |
| Sanctioned Estimate | | Date of written order to commence the work | | | |
| Contract Agreement/work Order No | | Date of commencement of work | | | |
| | | Due date of completion as per agreement | | | |
| | | Date of actual completion of the work | | | |

## I. ACCOUNT OF WORK EXECUTED

| On Account payment for the work not previously measured ** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total as per last running account bill Rs. | Since last running account bill Rs | Total up to date Rs | Item No of the agreement/ work order | Description of work | Quantity as per agreement | Quantity executed up to date | Rate Rs. P | Unit | Payment on the basis of actual measurement up to date Rs P | Quantity since last running account bill | Payment on the basis of actual measurement since last running account bill Rs P | Remarks |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
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BHARAT HEAVY ELECTRICALS LIMITED,
POWER SECTOR - EASTERN REGION, KOLKATA
TENDER NO. PSER:SCT:NBN-C2067:20

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| **II MEMORANDUM OF PAYMENT** | | | | | | | | | | | | |
| | | | | | | | | | | Rs. | P | |
| 1 | Total Value of work actually measured as per Account no I coloumn 10 | | | | | | | | (A) | | | |
| 2 | Deduct amount of paym,ents already made as per last running account bill No ……. Dated……. Forwarded to the Accounts Office on ……. | | | | | | | | (B) | | | |
| 3 | Payments now to be made { (A) - (B)} | | | | | | | | (C) | | | |
| 4 | Deduct ammounts recoverable from the contractor on account of : | | | | | | | | Rs | P | | |
| | a | Material suplied by BHEL vide annexure A attached | | | | | | | | | | |
| | b | Hire of Tools & Plants vide Annexure B attached | | | | | | | | | | |
| | c | Other charges vide Annexure C attached | | | | | | | | | | |
| | d | Income Tax | | | | | | | | | | |
| | | Total deduction | | | | | | | | | | |
| 5 | Balance | | | | | | | | | | | |
| 6 | Refund of 50% of security deposite on completion of work | | | | | | | | | | | |
| 7 | Net amount to be paid to the Contractor | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **III. CERTIFICATE OF THE ENGINEER IN CHARGE** | | | | | | | | | | | | |
| 1 | The measurement on which the entries in coulmns 7 to 12 of Part I of this bill (Account of work executed) are based were made by …….. (Name and designation) | | | | | | | | | | | |
| 2 | A statement showing the quantities of stores issued to the contractor (whether free or on recovery basis) and their disposal is attached. | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | Date: | | | | | | | | Signature of Engineer in charge | | | |
| | | | | | | | | | Designation | | | |
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**IV CERTIFICATE OF THE SENIOR ENGINEER**

1 Certified that I have personally inspected the work and that the work has been physically completed on the due date in accordance with the terms and

2 Cretified that the measurements have been check measured to the prescribed extent by ……. ……. (Name & designation). And by the the undersigned at site and relevent entries have been initiated in the measurement book (vide pages…… ….)

3 Certified that the methods of measurement are correct

4 Certified that the measurements have been technically checked with reference to contract drawings, deviations etc

5 Certified that all the measurements recorded in the measurement book have been correctly billed for at the contract rates or approved rates.

6 Certified that all the recoverable amounts in respect of stores, tools and pa\lant, e\water, electricity charges etc, have been correctly made vide Annexures A

7 Certified that the issues of all stores as per statement atytached (whether charged to the contractor or direct to the work) have been technically checked and

Certified for payment of * Rs ……. (Rupees…… (Only). To be paid in cash/by cheque in the presence of ……..

ALLOCATION

The expenditure as under and to be included in the accounts for ……..19

| Ledger Head …… | Debit (Gross Amount) Rs. P …… | Credit (Deduction) Rs. P …… |
|---|---|---|
| | | |
| | | |
| | | |
| Total | …… | …… |
| | | |
| | | |

* Here specify the net amount payable

Signature of Senior Engineer

Date

## V. ENTRIES TO BE MADE IN THE ACCOUNTS OFFICE

Account Bill no…… Dated ……
Entered in Journal book vide entry No……Dated……
Passed for……Rs……..
Less Deductions……..Rs……
(Rupees…….Only)
Payable to Shri/M/s…….... by cheque/cash
Entered in contractors' Ledger no..... Page

Assistant Accountant Accounts officer
Date: Date: Date:

ALLOCATION

Estimate No: Code No
Name of the Work ……

| Ledger Head | Debit (Gross Amount) Rs P | Credit (Deduction) Rs |
|---|---|---|
| …… | ..... | ..... |
| Total | ..... | ..... |

VI. Received Rs……..(Rupees……..Only) in full and final settlement of all moneys due under this contract and I / we have no further claims of this contract.

Signature of Witness
Address

Revenue Stamp
Signature of Contractor
Date:

## VII . ENTRIES TO BE MADE BY TREASURY SECTION

**Cash book entry no and date :**

**Amount Paid Rs…….**
**Amount unpaid Rs……..**
**Total Rs……..**

**Signature of Cashier**
**Date:**

ANNEXURE A

Part I

Statement showing details of material issued to the contractor Shri/M/s…….. In respect of Contract Agreement/Work Order No…….. Dated ……

| Sl No | Stores Issue voucher No and date | Issue voucher No and date alloted by stores to the SIV | description of material issued to the contractor | Quantity issued | Quantity actually incorporated in the work | Whether recoverable from the contractor or supplied free | If recoverable from contractor | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Rate at which recoverable Rs P | Amount Recoverable Rs P | Amount recoverable upto previous bill Rs P | Balance Now recovered Rs P | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
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| | Signature of Contractor | | | | | Signature of Engineer in charge | | | | Signature of Senior Engineer | |
| | Date | | | | | Date | | | | Date | |
| | | | | | | | | | | | |

ANNEXURE A

Part II

Statement showing details of material issued to the contractor Shri/M/s…….. in respect of Contract Agreement/Work Order No…….. Dated ……..……and not covered by the agreement

| Sl No | Stores Issue voucher No and date | Issue voucher No and date alloted by stores to the SIV | description of material issued to the contractor | Quantity issued | Quantity actually incorporated in the work | Issue Rate Rs P | Amount Recoverable Rs P | Amount recoverable upto previous bill Rs P | Balance Now recovered Rs P | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
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| | | | | | | Total | …… | | | |
| | | | | | | Add Departmental Charges<br>Add Sales Tax (wherever applicable) | …….. | | | |
| | | | | | | Total | …….. | | | |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | Signature of Contractor | | | | | Signature of Engineer in charge | | | | Signature of Senior Engineer |
| | Date | | | | | Date | | | | Date |

ANNEXURE B

Statement showing TOOLS & PLANTS issued to the contractor Shri/M/s…….. in respect of Contract Agreement/Work Order No…….. Dated ……and not covered by the agreement

| Sl No | Description of tools & plants issued | Period for which issued | Rate at which Recivery is to be made | Amount recoverable Rs P | Amount recoverable upto previous bill Rs P | Balance Now recovered Rs P | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
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| | Signature of Contractor | | | Signature of Engineer in charge | | | Signature of Senior Engineer |
| | Date | | | Date | | | Date |
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| ANNEXURE C | | | | | | | |

howing detail of other recoveries to be made from the contractor Shri/M/s……
ent/Work Order No……Dated……

| Sr.No | Particulars | Unit | Quantity | Rate Rs. P. | Amount recoverable Rs. P | Amount recovered upto previous bill Rs. P. | Amount now recovered Rs. P. | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | Water Charges | | | | | | | |
| 2 | Electricity Charges | | | | | | | |
| 3 | Seignorage Charges | | | | | | | |
| 4 | Medical Charges | | | | | | | |
| 5 | Cost of empty gunny bags and empty containers not returned | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| | | Total | | | | | | |

Signature of Contractor — Signature of Engineer Incharge — Signature of Sr. Engineer
Date — Date — Date

**ANNEXURE F**

Statement showing detail of materials issued to the contractor Shri/M/s……

t of Contract Agreement/Work Order No……Dated……

**Name of work;** **FREE OF COST**

| Sr.No | Stores issue voucher No. | ription of ma | Unit | Quantity issued | Quantity requried as per data | Quantity consumed in the work | Balance(If any) | Nature of disposal for the balance | Rate chargeable for material not returned Rs.P. | Amount recoverable for material not returned Rs. P | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
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| | Signature of Contractor | | | Signature of Engineer Incharge | | | Signature of Sr. Engineer | | | | |
| | Date | | | Date | | | Date | | | | |
| | | | | | | | | | | | |
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| | Note:Data statement of therotical consumption should be attached in support of the quantity specified in coloumn 6 | | | | | | | | | | |

BHARAT HEAVY ELECTRICALS LIMITED
DIVISION……
……And Final bill
(Para 4.3.2 Of Works Accounts Manual)

| | | | | | |
|---|---|---|---|---|---|
| Name of Contractor | | Departmental Bill no | | Date | |
| Name of the Work | | Division | | Division | |
| Sanctioned Estimate | | Date of written order to commence the work | | | |
| Contract Agreement/work Order No | | Date of commencement of work | | | |
| | | Due date of completion as per agreement | | | |
| | | Date of actual completion of the work | | | |

## I. ACCOUNT OF WORK EXECUTED

| On Account payment for the work not previously measured ** | | | Item No of the agreement/ work order | Description of work | Quantity as per agreement | Quantity executed up to date | Rate Rs. P | Unit | Payment on the basis of actual measurement up to date Rs P | Quantity since last running account bill | Payment on the basis of actual measurement since last running account bill Rs P | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total as per last running account bill Rs. | Since last running account bill Rs | Total up to date Rs | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |

BHARAT HEAVY ELECTRICALS LIMITED,
POWER SECTOR - EASTERN REGION, KOLKATA
TENDER NO. PSER:SCT:NBN-C2067:20

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | |
|---|---|---|
| Total Value of Work Done up to date | (A) | |
| Deduct Value of work shown on the last running account bill | (B) | |
| Net value of work done since last running account bill | (C) | |

Rupees (In Words).....Only

## II MEMORANDUM OF PAYMENT

| | | Rs. | P |
|---|---|---|---|
| 1 | Total Value of work actually measured as per Account no I coloumn 10 (A) | | |
| | Deduct amount of paym,ents already made as per last running account bill No ……. Dated……. | | |
| 2 | Forwarded to the Accounts Office on ……. (B) | | |
| 3 | Payments now to be made { (A) - (B)} (C) | | |
| 4 | Deduct ammounts recoverable from the contractor on account of : | Rs | P |
| | a Material suplied by BHEL vide annexure A attached | | |
| | b Hire of Tools & Plants vide Annexure B attached | | |
| | c Other charges vide Annexure C attached | | |
| | d Income Tax | | |
| | Total deduction | | |
| 5 | Balance | | |
| 6 | Refund of 50% of security deposite on completion of work | | |
| 7 | Net amount to be paid to the Contractor | | |

## III. CERTIFICATE OF THE ENGINEER IN CHARGE

The measurement on which the entries in coulmns 7 to 12 of Part I of this bill (Account of work executed) are based were made by ……..

1 (Name and designation)

2 A statement showing the quantities of stores issued to the contractor (whether free or on recovery basis) and their disposal is attached.

Date:

Signature of Engineer in charge
Designation

## IV CERTIFICATE OF THE SENIOR ENGINEER

1 Certified that I have personally inspected the work and that the work has been physically completed on the due date in accordance with the terms and
Cretified that the measurements have been check measured to the prescribed extent by ……
…… (Name & designation). And by the the undersigned at site and relevent entries have been initiated in the measurement book (vide
2 pages…… ….)
3 Certified that the methods of measurement are correct
4 Certified that the measurements have been technically checked with reference to contract drawings, deviations etc
5 Certified that all the measurements recorded in the measurement book have been correctly billed for at the contract rates or approved rates.
6 Certified that all the recoverable amounts in respect of stores, tools and pa\lant, e\water, electricity charges etc, have been correctly made vide Annexures A
7 Certified that the issues of all stores as per statement atytached (whether charged to the contractor or direct to the work) have been technically checked and

Certified for payment of * Rs ……. (Rupees…… (Only). To be paid in cash/by cheque in the presence of ……..

ALLOCATION

The expenditure as under and to be included in the accounts for ……..19

| Ledger Head | Debit (Gross Amount) Rs. P | Credit (Deduction) Rs. P |
|---|---|---|
| …… | …… | …… |
| Total | …… | …… |

* Here specify the net amount payable

Signature of Senior Engineer
Date

## V. ENTRIES TO BE MADE IN THE ACCOUNTS OFFICE

Account Bill no…… Dated …….
Entered in Journal book vide entry No……Dated……
Passed for……Rs……..
Less Deductions……..Rs……
(Rupees…….Only)
Payable to Shri/M/s…….... by cheque/cash
Entered in contractors' Ledger no..... Page

Assistant Accountant Accounts officer
Date: Date: Date:

ALLOCATION

Estimate No: Code No
Name of the Work ……

| Ledger Head | Debit (Gross Amount) Rs P | Credit (Deduction) Rs |
|---|---|---|
| ……. | ..... | ..... |
| Total | ..... | ..... |

VI. Received Rs……..(Rupees……..Only) in full and final settlement of all moneys due under this contract and I / we have no further claims of this contract.

Signature of Witness
Address

Revenue Stamp
Signature of Contractor
Date:

## VII . ENTRIES TO BE MADE BY TREASURY SECTION

**Cash book entry no and date :**

**Amount Paid Rs……**
**Amount unpaid Rs……..**
**Total Rs……..**

**Signature of Cashier**
**Date:**

ANNEXURE A

Part I

Statement showing details of material issued to the contractor Shri/M/s…….. In respect of Contract Agreement/Work Order No…….. Dated …….

| Sl No | Stores Issue voucher No and date | Issue voucher No and date alloted by stores to the SIV | description of material issued to the contractor | Quantity issued | Quantity actually incorporated in the work | Whether recoverable from the contractor or supplied free | If recoverable from contractor | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Rate at which recoverable | | Amount Recoverable | | Amount recoverable upto previous bill | | Balance Now recovered | | |
| | | | | | | | Rs | P | Rs | P | Rs | P | Rs | P | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | 9 | | 10 | | 11 | | 12 |

Total ……

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE A

Part II

Statement showing details of material issued to the contractor Shri/M/s…….. in respect of Contract Agreement/Work Order No…….. Dated ……and not covered by the agreement

| Sl No | Stores Issue voucher No and date | Issue voucher No and date alloted by stores to the SIV | description of material issued to the contractor | Quantity issued | Quantity actually incorporated in the work | Issue Rate Rs P | Amount Recoverable Rs P | Amount recoverable upto previous bill Rs P | Balance Now recovered Rs P | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Total ……

Add Departmental Charges

Add Sales Tax (wherever applicable) ……..

Total ……..

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE B

Statement showing TOOLS & PLANTS issued to the contractor Shri/M/s…….. in respect of Contract Agreement/Work Order No…….. Dated …….and not covered by the agreement

| Sl No | Description of tools & plants issued | Period for which issued | Rate at which Recivery is to be made | Amount recoverable Rs P | Amount recoverable upto previous bill Rs P | Balance Now recovered Rs P | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Total ……

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE C

showing detail of other recoveries to be made from the contractor Shri/M/s……
nent/Work Order No……Dated……

| Sr.No | Particulars | Unit | Quantity | Rate Rs. P. | Amount recoverable Rs. P | Amount recovered upto previous bill Rs. P. | Amount now recovered Rs. P. | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | Water Charges | | | | | | | |
| 2 | Electricity Charges | | | | | | | |
| 3 | Seignorage Charges | | | | | | | |
| 4 | Medical Charges | | | | | | | |
| 5 | Cost of empty gunny bags and empty containers not returned | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| | Total | | | | | | | |

Signature of Contractor
Date

Signature of Engineer Incharge
Date

Signature of Sr. Engineer
Date

Form WAM 7 (Contd.)

## ANNEXURE D

## DEVIATION STATEMENT

Name of the Contractor :
Name of the Work :

Contract Agreement/Work Order No. :
Date :

| Sl. No. | Description of item | Unit | Quantity as per agreement | Quantity as executed | Rate as per agreement Rs. P. | Rate as executed Rs. P. | Amount as per agreement Rs. P. | Amount as executed Rs. P. | Difference | | Reason for the deviation with authority, if any |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Excess Rs. P. | Savings Rs. P. | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

Signature of Engineer in Charge
Date :

Signature of Senior Engineer
Date :

Form WAM 7 (Contd.)

## ANNEXURE E

Statement showing the consumption of materials issued to the contractor Shri/M/s.....
in respect of Contract Agreement/Work Order No..... Dated.....

Name of the Work :

**ON RECOVERY BASIS**

| Sl. No. | Description of material | Unit | Quantity actually issued | Quantity actually incorporated in the work | Balance | Particulars of disposal of balance | Quantity to be issued as per approved data for work actually done | Variation in consumption (Difference between column 5 and 8) | | Rate chargeable for excess/ short consumption, if any | Amount recoverable for excess/ short consumption, including materials not returned | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | More | Less | Rs. P. | Rs. P. | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1. | Cement | | | | | | | | | | | |
| 2. | Bricks | | | | | | | | | | | |
| 3. | Wood..... | | | | | | | | | | | |
| 4. | Asbestos Sheet | | | | | | | | | | | |
| 5. | Iron Materials | | | | | | | | | | | |
| 6. | | | | | | | | | | | | |
| 7. | | | | | | | | | | | | |
| 8. | | | | | | | | | | | | |
| 9. | | | | | | | | | | | | |
| 10. | | | | | | | | | | | | |

Signature of Contractor
Date :

Signature of Engineer in Charge
Date :

Signature of Senior Engineer
Date :

Note : 1. The quantities shown in columns 4 and 5 above should tally with those shown in columns 5 and 6 respectively of Annexure A (Part I and II).

2. Data statement of theoretical consumption should be attached in support of quantity specified in column 8.

**ANNEXURE F**

Statement showing detail of materials issued to the contractor Shri/M/s……
ct of Contract Agreement/Work Order No……Dated……

**Name of work;** **FREE OF COST**

| Sr.No | Stores issue voucher No. | ription of ma | Unit | Quantity issued | Quantity requried as per data | Quantity consumed in the work | Balance(If any) | Nature of disposal for the balance | Rate chargeable for material not returned Rs.P. | Amount recoverable for material not returned Rs. P | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | | | | | | | | | | | |
| | | Total | | | | | | | | | |

Signature of Contractor
Date

Signature of Engineer Incharge
Date

Signature of Sr. Engineer
Date

Note:Data statement of therotical consumption should be attached in support of the quantity specified in coloumn 6

# ANNEXURE G



| | |
|---|---|
| **QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER** | |
| (Correct particulers and answers to be recorded) | |
| | |
| Name of the work : | |
| Name of the Contractor : | |
| Date of commencement of the work: | |
| Contract agreement/work ordered no. and date: | |
| Reference to supplementary agreement no,if any : | |
| Whether adminstrative approval and techanical sanction has been accorded by the cmpetent authority ? If so ,citc reference | |
| Whether sanction of the competent authority and financial concurrencr of the Accounts Departnment for award of the work has been accorded ? If so,cite reference. | |
| Wheter the work has been completed in time ? If not ,wheter penalty has been levied or sanction of the competent authority for extension of time granted and communicated to the Accounts Department with reasons for grant of extension? (Due and actual date of completion of the work and reference to letter no. and date granting the extension of time should be given) | |
| (a) Wheter the rates allowed in the bill have been checked with the contract agreement ? (b) Wheter the rates for extra/supplemental items have been approved by the competent authority and the sanction communicated to the accounts Department together wiht rate analysis? If so,cite reference. | |
| Wheter deviations have been approved by the competent authority? If yes, give reference to the approval; if not, give reasons. | |
| Whether the rates of recovery of stores issued to the contractor which are not provided for in the Contract Agreement have been settled in counsultation with Finance? | |
| Whether discrepancies pointed out by the Accounts Department in the store statement have been reconciled and accepted by the Accounts Department? | |

# ANNEXURE G

| QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER | |
|---|---|
| (Correct particulers and answers to be recorded) | |
| Whether materials issued to the contractor in excess of the theoretical requirements have been returned to the Stores Department and the no. and date of such retuened stores vouchers have been shown in stores statement? If not ,whether the cost of such excess material has been recovered at the prescribed rate? Whethre consumption statements in respect of materials chargeabale to the work have been attached to the bill? | |
| Whether consumption of materials shown has been technicaly checked by Senior Engineer? | |
| Whether materials isshued and used in the work is not less then that required for consumption in work accroding to our specification? If comsumption is less, whether necessary recovery has been made in the bill? | |
| Whether mesurments have been checked by the Engineer and Sr. Engineer to the extent required and certificates of check recorded in the mesurments books? | |
| Whether contractor has signed the bill and the mesurments books without reservations? If not; whether resones have been intimated to the Accounts Department? | |
| Whethet arithmatical calculations have been checked and certificate recorded in the mesurment books by a person other than the one who calculated initially | |
| Whether any work was done at the risk and cost of the contractor and whether such cost has been recovered from him? Give particulers. | |
| Whether all advance payments on running Accounts have been recovered? | |
| Whether tall the recovries due to services given to the contractor like rent of accommodation, water charges, electricity charges etc. have been recovered and wheather payments made by the company on behalf of the contractor have been adjusted? | |
| Whether the files containing abstracts from mesurments books/ standared mesurment books have been completed/ updated? | |
| Whether hire charges of tools and plant have been recovered and the statement of hire charges with full details attached? | |

# ANNEXURE G



| | |
|---|---|
| **QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER** | |
| (Correct particulers and answers to be recorded) | |
| Whether the certificate of workmanship and completion of work according to specifications, drawings etc. is recorded by Engineer/ Sr. Engineer and whether recoveries have been made for defective works, if any? | |
| Whether all corrections in the bill/measurement books etc. have been neatly made and attasted and there are no overwriting? | |
| Whether final measurments have been taken as soon as possibal after completion of work and the cretificate of complition issued? If not, whether resons for delay have been recorded and communicated to Accounts? | |
| In respect of Quintites reduced in the final bill as compare to the running payment, whether adequate reasons have been recorded and communicated to Accounts | |
| Whether the Expeinditure has been classified correctly according to heads of Account recorded in the sanctioned estimate? | |
| Whether the work has been completed within the estimated cost? If not, what is the percentage of excess over thw sanctioned estimate/ addministrative approval? In case the excess is beyond the competency of Sr. Engineer, what action has been taken for the obtaining the approval of the authority complent to sanction the excess? | |
| (a) If the contractor has furnished bank guarantee in lieu of cash sequrity deposit towards proper exicuation of works and guarantee against defectsduring the maintenance period, whether the period of currency of the bank guarantee cover the entire maintenance period? (b) If not, whether sequrity deposite has been proposed to be recovred from the final bill? | |
| Whether all the previous audit objections raised on running Account bills have been settled? If so, cite refrence. | |
| | |
| Signature of Engineer in Charge | Signature of Engineer in Charge |
| Date: | Date: |

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| PS- | MONTHLY PLAN & REVIEW WITH CONTRACTOR | Page **1** of **6** |
|---|---|---|

| Name of Project | | Contract No. | |
|---|---|---|---|
| Name of Work | | Name of Contractor | |

**PART- A: PLAN/ REVIEW OF WORK FOR THE MONTH OF ……..……..** Date of Plan/ Review……

| SN. | Description of Work | Unit of Measur-ement | Unit Rate | Planned (QTY Planned for the month as per Part –C of last month) | | Cumulative Shortfall attributable to contractor upto last month (Refer Note 1) | | Achieved | | Shortfall attributable to BHEL w.r.t Plan (as per Col. 3 of Part-D) | | Cumulative Shortfall attributable to Contractor upto & including this month | | REMARKS (Reasons for Shortfall attributable to Contractor. Supporting documents to be kept as record.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | A | | B | | C | | D | | E=A+B-C-D | | |
| | | | | Phy. | Financial | Phy | Financial | Phy. | Financial | Phy. | Financial | Phy. | Financial | |
| | | | | | | | | | | | | | | |
| | Value of Other Items not mentioned above but planned to be executed in this month | | | | | | | | | | | | | |
| Total | | | | | ΣA | | ΣB | | ΣC | | ΣD | | ΣE | |

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

| PS- | MONTHLY PLAN & REVIEW WITH CONTRACTOR | Page **2** of **6** |
|---|---|---|

| | | | |
|---|---|---|---|
| Name of Project | | Contract No. | |
| Name of Work | | Name of Contractor | |

**PART- A: Contd…….**

Note 1: **In addition to the work planned as per Col. 'A', Contractor shall also make full efforts to minimize the 'Cumulative shortfall attributable to contractor upto the month' as mentioned in Col. 'B' by enhancing its resources, so as to achieve the completion of activities as per agreed schedule. In case contractor is not able to execute the entire shortfall, then BHEL 'Engineer in-charge', shall decide the priority of work to be executed and it shall be binding on the contractor.**

Note 2: Percentage Shortfall attributable to contractor w.r.t. **"**Plan - Shortfall attributable to BHEL**"** for the month = [(ΣE-ΣB)/(ΣA-ΣD)]x100
In case, (ΣE-ΣB) is negative, then it shall be treated as zero percent."

Note 3: Form 14 should include all items being planned in the current month, and all items against which shortfall was attributable to contractor till previous month. However, for practical reason, if it is not possible to mention some of the items in Form-14 being planned to be executed in this month, then also value of such items shall necessarily be included in calculation of Total Value.

Note 4: In case reason for shortfall attributable to contractor is w.r.t. T&P and Manpower, it should be in conformity with Part B1 and B2.

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Form No: F-14 (Rev 01)

| PS- | MONTHLY PLAN & REVIEW WITH CONTRACTOR | Page **3** of **6** |
|---|---|---|

| Name of Project | | Contract No. | |
|---|---|---|---|
| Name of Work | | Name of Contractor | |

**PART – B-1: PLAN/REVIEW OF DEPLOYMENT OF MAJOR T&Ps FOR THE MONTH OF ……..……..** Date of Plan/ Review……

**CONTRACTOR'S SCOPE: -**

| SN. | PLAN | | | | DEPLOYMENT STATUS | | | |
|---|---|---|---|---|---|---|---|---|
| | Major T&P to be deployed as per work planned for the month | QTY | Deployment Period (in days) | Weightage assigned to planned T&P (in fraction such that ΣC =1) | Actual Deployed Quantity | Actual Deployment Period (in days) | Weighted T&P Deployed | REMARKS (Works affected due to non-deployment of T&Ps) |
| | | A | B | C | D | E | F=(C x D x E) / (A x B) | |
| | | | | | | | | |

Note: In case, E>B, it shall be considered as E=B. Similarly, in case D>A, it shall be considered as D=A.
Percentage of T&P Deployed = ΣF x 100

**BHEL SCOPE: -**

| SN. | PLAN | | | DEPLOYMENT STATUS | | |
|---|---|---|---|---|---|---|
| | Major T&P to be deployed as per work planned for the month | QTY | Deployment Period (in days) | Actual Deployed Quantity | Actual Deployment Period (in days) | REMARKS (Works affected due to non-deployment of T&Ps) |
| | | | | | | |

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Form No: F-14 (Rev 01)

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|---|---|---|

| Name of Project | | Contract No. | |
|---|---|---|---|
| Name of Work | | Name of Contractor | |

**PART – B-2: PLAN/ REVIEW OF DEPLOYMENT OF MANPOWER FOR THE MONTH OF ……..……..** Date of Plan/ Review……

**CONTRACTOR'S SCOPE: -**

| SN. | Area of Work | Category of Labour | No. of Labour required as per category | Deployment Period (in days) | No. of Labour actually deployed | Actual Deployment Period (in days) | REMARKS **(**Works affected due to non-availability of labour) |
|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | |
| | | | | | | | |

Percentage of Manpower Deployed=100 x Σ(CxD)/Σ(AxB)

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Form No: F-14 (Rev 01)

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|---|---|---|

| Name of Project | | Contract No. | |
|---|---|---|---|
| Name of Work | | Name of Contractor | |

**PART – C: PLAN(PHYSICAL) FOR THE NEXT MONTH i.e. ……..……..** Date of Plan ……

| SN. | Description of work | Original Planned Quantity | Planned Quantity (excluding shortfalls attributable to contractor till date) | Unit of Measu-rement | T&Ps Required | | | | Manpower Required | | REMARKS (Reasons for difference in Original Planned Quantity w.r.t. Planned quantity to be given) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Contractor Scope | | BHEL Scope | | Category of Labour | No. of Labour required as per Category | |
| | | | | | Major T&P to be deployed as per work planned for the month | Quantity | Major T&P to be deployed as per work planned for the month | Quantity | | | |
| | | | | | | | | | | | |

Note 1: Planned quantity should be based on available/ expected fronts/ inputs in the next month

Note 2: "Original Planned Quantity" shall be as per latest jointly agreed programme between BHEL and Contractor before commencement of work or at the time of latest Time Extension, as the case may be.

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

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| PS- | MONTHLY PLAN & REVIEW WITH CONTRACTOR | Page **6** of **6** |
|---|---|---|

| Name of Project | | Contract No. | |
|---|---|---|---|
| Name of Work | | Name of Contractor | |

**PART – D: REASONS FOR SHORTFALL ATTRIBUTABLE TO BHEL IN RESPECT OF PLAN FOR THE MONTH……**

| SN. | Description of Work (from Part-A) | Quantities Affected | | Reasons for Shortfall attributable to BHEL | Agency responsible for reasons for Shortfall | Remarks (Supporting Documents in respect of agency responsible) |
|---|---|---|---|---|---|---|
| | | (Physical Quantity) | Unit of Measu-rement | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | | | | |

Note1: Reasons for shortfall shall include non-availability of fronts/ drawings/ materials/ T&P (BHEL Scope)/ clearances etc. and other hindrances for which contractor is not responsible.

Note2: Agency responsible may be BHEL Site/ MUs/ Design Centre/ BHEL Customer/ other Contractors etc.

BHEL
(Sign with name, designation and date)

**BANK GUARANTEE FOR PERFORMANCE SECURITY**

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House, Siri Fort, Asiad, New Delhi – 110049 through its Unit at Bharat Heavy Electricals Limited, Power Sector Eastern Region, BHEL Bhawan, Plot No 9/1, DJ Block, Sector-II, Salt lake City, Kolkata – 700091 having awarded to ( Name of the Vendor / Contractor / Supplier) having its registered office at_____[1] hereinafter referred to as the 'Contractor/Supplier', which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref No……dated ……[2] valued at Rs……[2] ( Rupees ----------)for <Nature of Work>[3] (hereinafter called the 'Contract') and the Contractor having agreed to provide a Contract Performance Guarantee, equivalent to ……% (…. Percent) of the said value of the Contract to the Employer for the faithful performance of the Contract,

we, ……, (hereinafter referred to as the Bank), having registered/Head office at …….. and inter alia a branch at …… being the Guarantor under this Guarantee, hereby, irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer a maximum amount Rs ---------- ( Rupees ----------)[4] without any demur, immediately on a demand from the Employer, .

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____ _____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment thereunder and the contractors/supplier shall have no claim against us for making such payment.

We the ……bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We …….. BANK further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Contractor/Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall remain in force upto and including…….. [5] and shall be extended from time to time for such period as may be desired by Employer.
This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the ……[6] (3 months more than the present date of validity of Bank Guarantee) we shall be discharged from all liabilities under this guarantee thereafter.

We, …… BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.
Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…… [7]

b) This Guarantee shall be valid up to ……[8]

c) Unless the Bank is served a written claim or demand on or before _____[9] (3 months more than the present date of validity of Bank Guarantee) all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

*Any claim or dispute arising under the terms of this document shall only be enforced or settled in the courts of at Kolkata only.*

For and on behalf of
(Name of the Bank)

Dated…….

Place of Issue…….

*[1] NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.*

*[2] DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE*

*[3] PROJECT/SUPPLY DETAILS*

*[4] BG AMOUNT IN FIGURES AND WORDS*

*[5] VALIDITY DATE*

*[6] DATE OF EXPIRY OF CLAIM PERIOD*

*[7] BG AMOUNT IN FIGURES AND WORDS.*

*[8] VALIDITY DATE*

*[9] DATE OF EXPIRY OF CLAIM PERIOD*

**Note:**

1. **Units are advised that expiry of claim period may be kept 2/3 months after validity date.**

2. **In Case of Bank Guarantees submitted by Foreign Vendors-**

   a. **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

**b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**

**b.1** In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

**b.2** **In case, Foreign Vendors intend to provide BG from** Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.

**b.3** The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.

**b.4** The BG should clearly specify that the demand or other document can be presented in electronic form.

# BANK GUARANTEE FOR SECURITY DEPOSIT CUM PERFORMANCE BANK GUARANTEE BOND

B.G. NO. Date

This deed of Guarantee made this ---------- day of ----------two thousand ----- by <Name and Address of Bank> hereinafter called the "The Guarantor" (which expression shall unless repugnant to the context or meaning thereof be deemed to include its successors and assigns) in favour of M/s Bharat Heavy Electrical Limited ( A Govt. of India Undertaking) a company incorporated under the Companies Act, 1956, having its registered office at BHEL House, Siri Fort, Asiad, New Delhi – 110049 through its unit at <**Address of Power Sector Region**[1]> hereinafter called "The Company" (which expression shall unless repugnant to the context or meaning thereof be deemed to include its successors and assigns)

WHEREAS < Contractor's Name and Address> (hereinafter referred to as the Contractor) have entered into a contract arising out of Letter of Intent no. < LOI REF & Date > (hereinafter referred to as "the contract") for < Name of Work > with the company.

AND WHEREAS the contract inter-alia provides that the contractor shall furnish to the company a sum of Rs.---------- (Rupees----------) towards security deposit for due and faithful performance of the contract in the form and manner specified therein.

AND WHEREAS the contractor has approached the Guarantor and in consideration of the arrangement arrived at between the contractor and the Guarantor, the Guarantor has agreed to give the Guarantee as hereinafter mentioned in favour of the company.

The Guarantor do hereby guarantee to the company the due and faithful performance, observance or discharge of the Contract by the contractor and further unconditionally and irrevocably undertake to pay to the Company without demur and merely on a demand, to the extent of Rs.----------(Rupees----------) against any claim by the company on them for any loss, damage, costs, charges and expenses caused to or suffered by the company by reasons of the contractor making any default in the performance, observance or discharge of the terms, conditions, stipulations or undertakings or any of them as contained in the contract.

The decision of the company whether any default has occurred or has been committed by the contractor in the performance, observance or discharge of any of the terms, conditions, stipulations or undertakings or any one of them as contained in the contract and / or as to the extent of loss, damage, costs, charges and expenses caused to or suffered by the company by reason of the contractor making any default in the performance, observance or discharge of any of the terms, conditions, stipulations or undertakings or any one of them shall be conclusive and binding on the Guarantor irrespective of the fact whether the contractor admits or denies the default or questions the correctness of any demand made by the company in any Court, Tribunal or Arbitration proceedings or before any other Authority.

The company shall have the fullest liberty without affecting in any way the liability of the Guarantor under this Guarantee, from time to time to vary any of the terms and conditions of the contract or extend time of performance by the contractor or to postpone for any time and from time to time any of the powers exercisable by it against the contractor and either enforce or forebear from enforcing any of the terms and conditions governing the contract or securities available to the company and the Guarantor shall not be released from its liability under these presents by any exercise by the company of the liberty with reference to the matters aforesaid or by reasons of time being given to the contractor or any other forbearance, act or commission on the part of the company or any indulgence by the company to the contractor or any other matter or thing whatsoever which under the law relating to sureties would, but for this provision have the effect of so releasing the Guarantor from its liability under this guarantee.

The Guarantor further agrees that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the contract and its claim satisfied or discharged and till the company certifies that the terms and conditions of the contract have been fully and properly carried out by the contractor and accordingly discharges this Guarantee, subject however, that the company shall have no claim under this Guarantee after ---------- i.e. (3 months more than the present date of validity of Bank Guarantee unless the date of validity of this Bank Guarantee is further extended from time to time, as the case may be) unless a notice of the claim under this Guarantee has been served on the Guarantor before the expiry of the said period in which case the same shall be enforceable against the Guarantor not withstanding the fact that the same is enforced after the expiry of the said period.

## BANK GUARANTEE FOR SECURITY DEPOSIT CUM PERFORMANCE BANK GUARANTEE BOND

The Guarantor undertakes not to revoke this Guarantee during the period it is in force except with the previous consent of the Company in writing and agrees that any liquidation or winding up or insolvency or dissolution or any change in the constitution of the contractor or the Guarantor shall not discharge the Guarantor's liability hereunder.

It shall not be necessary for the company to proceed against the contractor before proceeding against the Guarantor and the Guarantee herein contained shall be enforceable against them notwithstanding any security which the Company may have obtained or obtain from the Contractor shall at the time when proceedings are taken against the Guarantor hereunder be outstanding or unrealized.

Notwithstanding anything contained herein before, our liability under the Guarantee is restricted to Rs.---------- (Rupees----------). Our guarantee shall remain inforce until ----------, i.e. (the present date of validity of Bank Guarantee unless the date of validity of this Bank Guarantee is further extended from time to time) unless a claim or demand under this guarantee is made against us on or before ---------- (3 Months more than the validity date) we shall be discharged from our liabilities under this Guarantee thereafter.

Any claim or dispute arising under the terms of this documents shall only be enforced or settled in the courts of at < **Name of place[2]** > only.

The Guarantor hereby declares that it has power to execute this guarantee and the executant has full powers to do so on behalf of the Guarantor.

IN WITNESS whereof the ---------- (Bank) has hereunto set and subscribed its hand the day, month and year first, above written.

(Name of the Bank)

Signed for and on behalf of the Bank
(Designation of the Authorized Person Signing the Guarantee)

(Signatory No.----------)

DATED:

SEAL

==========

Notes :

1. **Address of Power Sector Regions (inviting the Tender)** is as below:
   - PSNR : Bharat Heavy Electricals Limited, Power Sector Northern Region, HRDI & PSNR Complex, Plot No 25, Sector 16-A, Noida – 201 301 (Uttar Pradesh)
   - PSER : Bharat Heavy Electricals Limited, Power Sector Eastern Region, BHEL Bhawan, Plot No 9/1, DJ Block, Sector-II, Salt lake City, Kolkata – 700 091
   - PSWR: Bharat Heavy Electricals Limited, Power Sector Western Region, Shree Mohini Complex, 345 Kingsway, Nagpur 440 001
   - PSSR: Bharat Heavy Electricals Limited, Power Sector Southern Region, 690, Anna Salai, Nandanam, Chennai 600 035

2. **Name of place (for jurisdiction of Courts)** is as below:
   - PSNR : Delhi
   - PSER : Kolkata
   - PSWR: Nagpur
   - PSSR : Chennai

3. The BG shall be executed on non-judicial stamp papers of adequate value procured in the name of the Bank in the State where the Bank is located.

4. The BG is required to be sent by the executing Bank directly to BHEL at the address where tender is submitted / accepted under sealed cover.

**BANK GUARANTEE FOR RELEASE OF AMOUNTS WITHHED/LIQUIDATED DAMAGES AMOUNT**

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited [1](hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House, Siri Fort, Asiad, New Delhi – 110049 through its Unit at Bharat Heavy Electricals Limited, Power Sector Eastern Region, BHEL Bhawan, Plot No 9/1, DJ Block, Sector-II, Salt lake City, Kolkata – 700091 having awarded to ( Name of the Vendor / Contractor / Supplier) incorporated under the ……..having its registered office at_____ [1](hereinafter referred to as the 'Contractor', which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref No……dated ……..[2]valued at Rs……( Rupees ----------) for <Nature of Work>[3](hereinafter called the 'Contract')

The Contractor as per Contract should have completed the work/ supplies under the contract by……..(date). As per terms and conditions of the Contract, the Employer is entitled to levy Liquidated Damages (LD) for delays and the Employer has withheld an amount of Rs ……..by way of LD as per the Contract. Now, on the request of the Contractor, the Employer having agreed to release the amount of Rs……..withheld from the Contractor's invoices as Liquidated damages under the terms and conditions of the Contract on production of a Bank Guarantee for Rs._____ (Rupees……only) [4]

We, ……, (hereinafter referred to as the Bank), having registered/Head office at …….. and inter alia a branch at ……. being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer a maximum amount of Rs ---------- ( Rupees ----------) without any demur, merely on a demand from the Employer

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment thereunder and the contractors/supplier shall have no claim against us for making such payment.

We the ……bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We …….. BANK further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Contractor/Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.
The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's/ Supplier's liabilities.

This Guarantee shall remain in force upto and including…….. [5] and shall be extended from time to time for such period as may be desired by Employer.
This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writingon or before the ……[6] (3 months more than the present date of validity of Bank Guarantee) we shall be discharged from all liabilities under this guarantee thereafter.

We, …… BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…… [7]
b) This Guarantee shall be valid up to ……[8]
c) Unless the Bank is served a written claim or demand on or before _____[9] (3 months more than the present date of validity of Bank Guarantee) all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

Any claim or dispute arising under the terms of this document shall only be enforced or settled in the courts of at Kolkata only.

For and on behalf of
(Name of the Bank)

Dated…….

Place of Issue…….

[1] *NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.*

[2] *DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE*

[3] *PROJECT/SUPPLY DETAILS*

[4] *BG AMOUNT IN FIGURES AND WORDS*

[5] *VALIDITY DATE*

[6] *DATE OF EXPIRY OF CLAIM PERIOD*

[7] *BG AMOUNT IN FIGURES AND WORDS.*

[8] *VALIDITY DATE*

[9] *DATE OF EXPIRY OF CLAIM PERIOD*

**Note:**

1. **Units are advised that expiry of claim period may be kept 2/3 months after validity date.**

2. **In Case of Bank Guarantees submitted by Foreign Vendors-**

   **a.** **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

   **b.** **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**

   **b.1** In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

   **b.2** **In case, Foreign Vendors intend to provide BG from** Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.

   **b.3** The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.

   **b.4** The BG should clearly specify that the demand or other document can be presented in electronic form.

**BANK GUARANTEE FOR SUPPLY FREE ISSUE MATERIAL.**

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House, Siri Fort, Asiad, New Delhi – 110049 through its Unit at Bharat Heavy Electricals Limited, Power Sector Eastern Region, BHEL Bhawan, Plot No 9/1, DJ Block, Sector-II, Salt lake City, Kolkata – 700091 having awarded to ( Name of the Vendor / Contractor / Supplier).having its registered office at_____ [1] (hereinafter referred to as the 'Contractor/Supplier/Fabricator' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref. No.……dated ……[2] valued at Rs.……( Rupees ----------) for <Nature of Work>[3] (hereinafter called the 'Contract')

and, the Employer having agreed as per the terms and conditions of the Contract to supply free issue material costing Rs._____ for the manufacture/fabrication of the equipment at the Contractor's site on on furnishing a Bank Guarantee for Rs._____ (Rupees……..)[4] in the manner hereinafter specified for the due safeguard of the free issue material,

we, ……, (hereinafter referred to as the Bank), having registered/Head office at …… and inter alia a branch at …… being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer a maximum amount of Rs ---------- ( Rupees ----------) without any demur, merely on a demand from the Employer, .

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment hereunder and the Contractors/Supplier shall have no claim against us for making such payment.

We the ……Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We …….. Bank further agree that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Contractor/Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor/Supplier/ Fabricator and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's/Supplier's/ Fabricator's liabilities.

This Guarantee shall remain in force upto and including…….. [5] and shall be extended from time to time for such period as may be desired by Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/ Supplier/ Fabricator but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the ……[6] (3 months more than the present date of validity of Bank Guarantee) we shall be discharged from all liabilities under this guarantee thereafter.

We, …… BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…… [7]
b) This Guarantee shall be valid up to ……[8]
c) Unless the Bank is served a written claim or demand on or before _____[9] (3 months more than the present date of validity of Bank Guarantee) all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

Any claim or dispute arising under the terms of this document shall only be enforced or settled in the courts of at Kolkata only.

For and on behalf of
(Name of the Bank)

Dated…….

Place of Issue…….

*[1] NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER .*

*[2] DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE*

*[3] PROJECT/SUPPLY DETAILS*

*[4] BG AMOUNT IN FIGURES AND WORDS*

*[5] VALIDITY DATE*

*[6] DATE OF EXPIRY OF CLAIM PERIOD*

*[7] BG AMOUNT IN FIGURES AND WORDS.*

*[8] VALIDITY DATE*

*[9] DATE OF EXPIRY OF CLAIM PERIOD*

**Note:**

1. **Units are advised that expiry of claim period may be kept 2/3 months after validity date.**

2. **In Case of Bank Guarantees submitted by Foreign Vendors-**

   a. **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

   b. **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**

   **b.1** In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

   **b.2** **In case, Foreign Vendors intend to provide BG from** Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.

   **b.3** The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.

   **b.4** The BG should clearly specify that the demand or other document can be presented in electronic form.

## PROFORMA OF BANK GUARANTEE FOR EARNEST MONEY
## (On non-Judicial paper of appropriate value)

**Bank Guarantee No…….**

**Date……..**

**To**

(Employer's Name and Address)
……..

Dear Sirs,

In accordance with the terms and conditions of your Invitation for Bids/Notice Inviting Tender No……[1](Tender Conditions) M/s. ……. having its registered office at ……[2] (hereinafter referred to as the '**Tenderer**'), is submitting its bid for the work of**…….** for……[3]. at Bharat Heavy Electricals Limited, Power Sector Eastern Region, BHEL Bhawan, Plot No 9/1, DJ Block, Sector-II, Salt lake City, Kolkata – 700091.[4](name of the Employer)
The Tender Conditions provide that the **Tenderer** shall pay a sum of Rs **…….** as Earnest Money Deposit in the form therein mentioned. The form of payment of Earnest Money Deposit includes Bank Guarantee executed by a Scheduled Bank.

In lieu of the stipulations contained in the aforesaid Tender Conditions that an irrevocable and unconditional Bank Guarantee against Earnest Money Deposit for an amount of .....[5] ..... is required to be submitted by the Tenderer as a condition precedent for participation in the said Tender and the Tenderer having approached us for giving the said Guarantee,,

we, the .....*[Name & address of the Bank]* ..... having our Head Office at ……..(hereinafter referred to as the Bank) being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer without any demur, merely on your first demand any sum or sums of Rs. [5] .....(*).....without any reservation, protest, and recourse and without the beneficiary needing to prove or demonstrate reasons for its such demand. Any such demand made by the 'Employer' shall be

conclusive and binding on us irrespective of any dispute or difference raised by the Tenderer.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment hereunder and the Tenderer shall have no claim against us for making such payment.

We …….. Bank further agree that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Tender or to extend the time of submission of bids from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Tenderer and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Tendered or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Tenderer or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Tenderer and notwithstanding any security or other guarantee that the Employer may have in relation to the Tenderer's liabilities.

This Guarantee shall be irrevocable and shall remain in force upto and including……[6] and shall be extended from time to time for such period as may be desired by the Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Tenderer but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms hereof. However, unless a demand or claim under this Guarantee is made on us in writing on or before the ……[7] we shall be discharged from all liabilities under this Guarantee.

We, ……. Bank lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed……[5]…..

b) This Guarantee shall be valid up to ……[6]

c) Unless the Bank is served a written claim or demand on or before _____[7] all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of

(Name of the Bank)

Date……

Place of Issue……

[1] *Details of the Invitation to Bid/Notice Inviting Tender*

[2] *Name and Address of the Tenderer*

[3] *Details of the Work*

[4] *Name and Address of BHEL Unit/Division/Region (Already filled up)*

[5] *BG Amount in words and Figures*

[6] *Validity Date*

[7] *Date of Expiry of Claim Period*

**Note:**

1. **Units are advised that expiry of claim period may be kept 2/3 months after validity date. As per Works Policy, the Bank Guarantee shall be valid for at least six months.**

2. **In Case of Bank Guarantees submitted by Foreign Vendors-**

**a.** **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

**b.** **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**

**b.1** In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter-Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

**b.2** **In case, Foreign Vendors intend to provide BG from** Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.

**b.3** The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.

**b.4** The BG should clearly specify that the demand or other document can be presented in electronic form.

*Form for getting payment through RTGS (Real Time Gross Settlement)*

| | | |
|---|---|---|
| 01. | *Name of Vendor* | BHARAT HEAVY ELECTRICALS LTD. |
| 02. | *Address* | ~~BHEL~~ BHEL HOUSE, SIRI FORT, N.DELHI |
| 03. | *Vendors Bank A/c Name* | BHARAT HEAVY ELECTRICALS LTD. |
| 04. | *Vendors Bank A/c No.* | 11107800029 |
| 05. | *Name of Bank* | STATE BANK OF INDIA |
| 06. | *Name of Branch* | COMMERCIAL BR., SALT LAKE, SECTOR-V KOLKATA |
| 07. | *Branch Phone No.* | 033-23575666 |
| 08. | *City* | KOLKATA |
| 09. | *IFSC Code of the Branch* | SBIN 0004289 |

*The charges if any for payment through RTGS may be recovered from the Bill submitted by us.*

*Signature of Authorised Representative of Vendor with office seal*

के. के. कोआरी / K. K. Coari
उप महाप्रबंधक (वित्त) / Dy. General Manager (Fin)
बी. एच. ई. एल. : पी.एस.ई.आर : कोलकाता - 700 091
BHEL : PSER / Kolkata-700 091

*Confirmation by Banker with office seal*

State Bank of India ★ (SALT LAKE) 4289 ★ Commercial Branch

*Note : Incorrect information will create Accounting complications and payment will be delayed*

**TENDER NO: PSER:SCT:NBN-C2067:20**

**VOLUME -IF**

# TECHNICAL CONDITIONS OF CONTRACT

(TCC)

**FOR**

CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.


## BHARAT HEAVY ELECTRICALS LIMITED

**( A GOVT. OF INDIA UNDERTAKING )**
**POWER SECTOR – EASTERN REGION**
**PLOT NO. – 9 / 1, DJ – BLOCK,**
**SECTOR – II, KARUNAMOYEE,**
**SALT LAKE CITY,**
**KOLKATA – 700091.**

**TENDER NO: PSER:SCT:NBN-C2067:20**

**VOLUME -IF**

# TECHNICAL SPECIFICATION

(TS)

**FOR**

CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.


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These Technical conditions shall be construed as part of tender document and shall be read along with General Conditions of Contract. In case of any conflict or inconsistency between the general and these technical conditions, the same shall be brought out by the bidder in writing to BHEL for clarification during pre-bid discussions; failing which most stringent interpretation / clause in favour of BHEL shall be adopted and the same shall be binding to the contractor.

| CLAUSE NO | DESCRIPTION |
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| 1.1 | **PROJECT SYNOPSIS AND GENERAL INFORMATION** |
| | NTPC (for BHARATIYA RAIL BIJLEE COMPANY LTD.) is setting up four units of 4x250 MW Thermal Power station (coal based) at Nabinagar, District- Aurangabad, State of Bihar.<br><br>The Plant site is located at North: 24 deg. 42' 30" (N) and East: 84 deg. 05' 36" (E). Nearest Railway station is Dehri-On-Sone which is approx. 30 KM away from the project site. The nearest major town Aurangabad is located at a distance of about 50 Kms. from Project site.<br><br>Nearest Railway Station : Dehri-On-Sone Railway Station<br>( Approx. 30 KMs from the Plant)<br><br>Nearest Airport : Gaya<br>( Approx. 100 KMs from the Plant)<br><br>Nearest Highway is National Highway-2 which is 25KM away from the project site. |
| **2.0** | **SITE VISIT** |
| | The contractor should visit project site and acquire full knowledge and information about conditions prevailing at site and in & around the plant premises, together with all the statutory, obligatory, mandatory requirements of various authorities necessary for preparing the bid and entering into the contract. All costs for and associated with site visits shall be borne by the bidder. |
| **3.0** | **SCOPE OF WORK** |
| 3.1 | The work to be done under this specification comprises of construction of 150 M high reinforced concrete single steel flue chimney and other incidentals complete as detailed in the specification under Volume-II and elsewhere in the tender document, including raft foundation for Chimney for FGD system at 4 X 250 MW BRBCL Nabinagar Thermal Power Project, Aurangabad, Bihar. |
| 3.2 | The scope of work is as follows:<br><br>A. Construction of 04 numbers 150-meter-high reinforced concrete single flue steel lined chimney and other incidentals as detailed in the specification in the tender document including providing all labour, materials (except those which are specifically mentioned to be issued by BHEL as Free of Cost (FOC) Items), consumables, equipment, temporary works, temporary storage sheds, temporary colony for labour and staff, temporary site offices, construction plants, transportation/handling and all incidental items not shown or specified but reasonably implied or necessary for the completion of subject scope, all in strict accordance with the specifications including revisions and amendments thereto as may be required during the execution of work.<br><br>B. Supply including design, receipt, unloading, erection, testing and commissioning of stack elevator and electrical equipments; allied items, cabling, earthing, spares etc. are also under the scope of this work. The complete works have to be carried out by providing all labour, supervision, materials, scaffolding, power, fuel, construction equipments, tools & plants, inspection, measuring, testing instruments, supplies, transportation, storage, and all incidental items not herein specifically mentioned but reasonably or found required for the successful completion of work including contractor's and where necessary manufacturer's expert supervision in strict compliance with the requirement of this specification and approved |

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| | construction drawing.<br><br>C. Installation of Borosilicate Glass Lining inside MS Flue Cans, including surface preparation, application of primer, adhesive etc. as per the technical specifications and approved erection procedure under the expert supervision of Borosilicate Glass Lining manufacturer /supplier. The complete works have to be carried out by providing all labour, supervision, materials, scaffolding, power, fuel, construction equipment, tools & plants, inspection, measuring, testing instruments, supplies, transportation, storage, and all incidental items not herein specifically mentioned but reasonably or found required for the successful completion of work. Borosilicate Glass Lining Materials, Primer, Adhesive (suitable fixing materials) and Expert Supervision of Manufacturer shall be provided by BHEL as Free of Cost (FOC) Items. |
| 3.3 | The bidder's scope shall include excavation in soil and rock ( if any with/without blasting as per the site conditions), dewatering, dressing to required profile, sheet piling or shoring/strutting, backfilling around completed structures and plinth filling, plinth protection, disposal of surplus earth and rock, concreting including Reinforcement and Formwork, Masonry work, Plastering, Painting, Flooring, Installation of borosilicate lining, Doors/Windows, Ventilators, Fire Proof Doors, Insulation, Roof Water Proofing, Dismantling of existing structures (below ground and above ground- RCC, Brick Works, Sheeting, Structural steel and Other facilities), RCC and Brick/ Block masonry and Steel Structures, fabrication and erection of all structural steel and miscellaneous steel (i.e. steel stair case, cable/duct/pipe supports, ladders, walkways, railing, Chequered plate/grating floor, inserts, anchor bolts, etc.), paving, Embedment, Earthing, Gravel filling, Precast covers, Expansion joints, Rain water pipe, Insulation, Gates/Valves, Water proofing of underground structures,Trenches, Final grading and site clearance before handing over to Owner and other auxiliary items of work, etc. all complete including supply of all materials (except those which are specifically mentioned to be issued by BHEL as Free of Cost (FOC) Items), consumables, labor, Tools and plants, transportation and storage, Sample Testing etc. all complete as per BOQ, specifications and drawings for proper and successful execution of the job for FGD at 4x250 MW BRBCL Nabinagar Thermal Power Project, Aurangabad, Bihar. |
| 3.4 | Ready mix cement concrete required for the tender scope (except chimney shell) shall be procured by BHEL and issued to contractor as free of cost (FOC) Item. at Batching Plant inside the plant premises. Bidder has to transport the concrete from batching plant to the location of work. Bidder to submit a receipt of concrete at batching plant based on the print out of batching. Reconciliation of quantity of concrete shall be done based on actual use of concrete at site.<br>Chimney shell concrete supply & laying is in the scope of contractor.<br>For concrete supplied by the contractor, the cement (contractor's scope) shall be as per Technical specification, applicable IS Codes and description mentioned in the respective items of BOQ.<br>Test certificates in respect of Cement for each consignment to be furnished and also to be tested as per FQP before use. The contractor shall submit the consumption statement of cement used in the works along with bill. |
| 3.5 | Reinforcement Steel required for the tender scope shall be procured by BHEL and issued to contractor as free of cost (FOC) Item except for those items wherever specifically mentioned in contractor's scope in BOQ.<br><br>However, unloading, handling / storage of Reinforcement steel procured by BHEL for this tender scope, at site, inside BHEL Stores / Contractor's Stores and further transportation from Stores to work area will be in the scope of contractor. No Extra payment shall be made for this work. |
| 3.6 | **Fabricated Structure Steel Supply:**<br>Structural Steel required for the tender scope shall be procured by BHEL and issued to contractor as free of cost (FOC) Item, except for those items wherever specifically mentioned in contractor's scope in BOQ. |

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| | All steel structures (vendor's scope supply) shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections. Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. However, BHEL will issue required material at site only. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded. Structural Steel shall be fabricated at a suitable fabrication shop, outside the plant premises.<br><br>BHEL will visit the fabrication shop of Contractor to examine its suitability for the scope of work involved. However, contractor's fabrication shop shall be adequately equipped to handle the scope of work involved within the given time schedule. Any modifications / alterations as required to carry out the works shall be done by contractor at his own cost. No claim / compensation for delay in works on this account will be admitted.<br><br>Contractor shall designate separate areas inside its fabrication shop for storage of Raw Materials as well as fabricated materials for this tender's scope and materials supplied for this work shall solely be utilized for this tender's purpose only. Safety, Watch and Ward, Insurance of the materials procured, fabricated and stored inside fabrication shop and transit insurance shall be the responsibility of the contractor. No claims / compensation on account of damage / theft of materials which is in the custody of contractor shall be permitted.<br><br>Contractor shall give due notice in advance to BHEL for Stage Inspection of the works being carried out at its fabrication shop as per the approved FQP. However, BHEL Engineer shall be entitled to visit the Contractor's Fabrication shop at any feasible time during the period of execution to examine the progress and quality of work. Contractor shall always maintain all such records and provide facilities / equipment / MMEs as required by BHEL's Engineer for inspection of works within the quoted rates. Fabricated Structural Steel shall be dispatched from the shop only after getting the due clearance from BHEL /Customer.<br><br>Transportation of fabricated structure steel / Raw Structure Steel from shop to site, Unloading, Handling / storage, at site, inside BHEL Yard / Contractor's store, will be in the scope of contractor. No extra payment for unloading / handling / transportation shall be paid to contractor. |
| 3.7 | The scope shall also include setting up by the bidder a testing room with compressive strength testing machine and other site test instruments for conducting day to day testing of concrete cubes, compaction of earth & road work, brick & other material testing. One qualified quality engineer to be deployed as necessary. |
| 3.8 | The working area shall be separated from the existing plant area by cordoning off the area by providing MS / GI sheets of suitable heights with appropriate frame work as approved by BHEL/ Customer. No extra payment shall be paid to contractor for this work. |
| 3.9 | The contractor shall also provide 1 (one) no computer operator and 1 (one) number service staff for miscellaneous service for BHEL's use at site / Kolkata for reconciliation, progress review & day-to-day planning purpose, documentation etc. These facilities are to be provided within 30 days from LOI date till completion of scheduled contract period.<br><br>Persons so deployed shall have to work in extended hours whenever required. Workmen provided as per the above provisions shall be fully trained and experienced in the nature of work for which they are deployed.<br><br>In case contractor fails to provide above-mentioned manpower as desired by BHEL, the latter shall have the right to hire such services from other agencies at the risk and cost of the contractor or BHEL will recover amount against the non-deployment period as per recovery rate mentioned under clause no 14.1.3.1 & 14.1.3.2 of TCC, |

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| | whichever is applicable.<br><br>However, if BHEL does not utilize the man months as per above provision, fully or partly; recovery at the rate of the prevailing minimum wages at Nabinagar along with statutory expenses i.e. PF, ESI, bonus etc. (as applicable) for the categories given plus 10% will be made from the final bill of the contractor. |
| 3.10 | The Customer National Thermal Power Corporation (NTPC) may depute their representative for checking and supervision of important stages of work. The contractor shall be required to provide all facilities for inspection of works at no extra cost to BHEL. Any defect in quality of work or deviations from drawings / specifications pointed out during such inspection shall be made good by the contractor in the same way as if pointed out by the BHEL Engineer, without any cost implication to BHEL. |
| 3.11 | The work under this contract shall be carried out as per BOQ Cum Rate Schedule. In case the description / specifications as per BOQ are found to be incomplete, Indian standard specifications shall be followed. Quantities mentioned in the BOQ cum Rate schedules are approximate only and liable for variation due to change of scope of work / variation in schedule of quantities, changes in design etc. The tenderers shall undertake to execute actual quantities as per advice of BHEL Engineer and accordingly the final contract price shall be worked out on the basis of quantities actually executed at site and payments will also be regulated for the same. The quantities indicated against each item may vary to any extent and no compensation will be payable in variation of Individual quantity. |
| 3.12 | The complete works shall be carried out as per BOQ cum Rate schedule. If any work covered in the scope of contract cannot be executed using items available in BOQ, additional / extra items shall be made and rates for such items shall be worked out as per tender. However contractor shall be bound to execute all the works under the scope of the contract and decision whether an extra item is applicable or not, shall be taken by BHEL Engineer which will be binding on the contractor. |
| 3.13 | Any activity which is necessarily required for satisfactory execution of any item of BOQ in line with technical specifications shall be deemed to be included in BOQ item even if it is not described in the item description and no extra payment shall be made against such activity. |
| 3.14 | **The technical requirements for work to be executed under this specification shall be as per Specifications enclosed with this tender document.** |
| 3.15 | All quality standards, tolerances, welding standards & other technical requirements shall be strictly adhered to. The Bidder shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site-specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications. |
| 3.16 | Contractor’s scope also includes following: |
| 3.16.1 | Furnishing all labor, materials (except those specified in BHEL scope), supervision, construction plans, equipment, supplies, transport to and from the site, materials handling, fuel, electricity, compressed air, water, transit and storage insurance and all other incidental items and temporary works not shown or specified but reasonably implied or necessary for the proper completion, maintenance and handing over the works, in accordance with the stipulations laid down in the contract documents and additional stipulations as may be provided by BHEL Engineer during the course of works. |
| 3.16.2 | Furnishing samples of all materials required by the engineers for testing / inspection and approval for use in the works. The samples may be retained by the engineer for final incorporation in the works.<br>Furnishing test reports for the products used or intended to be used, if called for the specifications or if so desired by the engineer. |
| 3.16.3 | Giving all notices, paying all fees, taxes etc., in accordance with the general conditions of contract, that are required for all works including temporary works. |
| 3.16.4 | Arranging manufacturer’s supervision for items of work done as per manufacturer’s |

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| | specifications when so specified. |
| 3.16.5 | The scope of work will also include such other related works although they may not be specifically mentioned in the above paragraph and all such incidental items not specified but reasonably implied and necessary for completion of the job as a whole all as desired and as directed by the engineer. |
| 3.16.6 | The scope of work covered above is not a comprehensive list of items of work involved. The detail scope of work may vary considerably depending on the actual construction requirements. |
| 3.17 | APPROVED MANUFACTURER / SUB VENDOR |
| 3.17.1 | As instructed by BHEL and as per approved FQP, Materials to be procured by the bidder must be approved by BHEL / NTPC. A tentative list of suppliers of some of the items is provided herewith this document. For suppliers other than those mentioned in the list, specific approval of BHEL / NTPC will be required. |
| 3.17.2 | **STACK ELEVATOR** |
| | Stack elevator to be supplied through BHEL / NTPC approved stack elevator manufacturer as furnished below: |
| | Alikraft Engineers Pvt Ltd- Savli, Vadodara |
| | Universal Construction Machinery- Pune |
| | Sucessful bidder can propose name of vendors other than above mentined vendors but acceptance shall be subject to approval by NTPC.Deceision of NTPC in this regard shall be final and binding to BHEL/Sucessful bidder. |
| 3.18 | **INSPECTION & JOINT VERIFICATION (AT CONTRACTOR'S WORKS)**<br>Prior to dispatch, the materials would be offered by the contractor for joint inspection at the contractor's works as detailed in this tender specifications for which the contractor would serve the advance notice of 15 days for inspection call to BHEL. |
| 3.19 | **INSPECTION & JOINT VERIFICATION (AT SITE)**<br>The contractor shall be intimated within 7 days from the date of receipt of each consignment at site to depute their representative for joint inspection and verification of the equipment / materials received at site. The contractor shall depute their representative within 7 days from receipt of such intimation failing which BHEL shall proceed with the inspection and verification of equipment / materials and BHEL's decision in this regard shall be final and binding to the contractor. |
| 3.20 | **QUALITY PLAN**<br>The bidder shall furnish the quality assurance plan along with the offer which would be approved by BHEL / Owner. |
| 3.21 | **MATERIAL DESPATCH CLEARANCE CERTIFICATE (MDCC):**<br>MDCC shall be issued by BHEL / Owner or their authorized representative prior to dispatch. In case the tests are not witnessed by BHEL / Owner / Owner's representative, the test certificates shall be submitted and MDCC will be issued thereafter. MRC shall be issued by BHEL / Owner or their authorized representative after the material is received at site in good condition. |
| **4.0** | **DEVIATIONS / CLARIFICATIONS** |
| | The bidder is required to submit with his offer in the relevant schedule / format without any ambiguity. Any assumptions, presumptions, deviations etc. indicated or implied anywhere by the bidder except those indicated in the deviation schedule / format will not be recognized and will not form a part of consideration / offer. In the absence of such filled-up schedule / format it will be understood and agreed that the bidder's offer is based on strict conformance to the specification and no negotiation would be allowed in this regard. BHEL reserve the right not to recognize any / all deviations submitted after opening of the bid. |
| **5.0** | **DEWATERING** |
| | Contractor shall ensure at all times that his work area & approach / access roads are free from accumulation of water, so that the materials are safe and the erection/ progress schedule are not affected. No separate claim in this regard shall be admitted by BHEL. No separate payments for dewatering of subsoil, surface water or catchments water, if required, at any time during execution of the work including monsoon period shall be considered by BHEL. |
| **6.0** | **LAND** |

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| 6.1 | Availability of land within plant boundary is very limited and the contractor has to plan & use the existing land considering the use of land by other contractors and the storage of plant machineries and materials. The existing land shall be shared by all erections agencies. The same will be reviewed by BHEL and allotted to the extent available/ considered necessary free of cost. Contractor shall develop these areas for their site office, their own stores etc. Bidder must visit site to assess site condition, prior to quoting. |
| 6.2 | Levelled area for storage area for BHEL's material shall be provided as per availability free of cost. |
| 6.3 | Land for labour colony shall be arranged by successful bidder at their own. The contractor shall construct labour colony / hutment as per his requirements after obtaining approval of formalities from statutory body. Further, contractor must ensure minimum HSE norms and hyeiginic sanitary conditions in his labour colony. |
| 6.4 | The contractor will be responsible for handing back all lands, as handed over to him by BHEL/NTPC. |
| **7.0** | **WATER** |
| 7.1 | BHEL will provide single point supply for construction & drinking water inside the project premises for office free of cost within 500 Mtr. of work site. |
| 7.2 | Further necessary network for construction & drinking water system shall be done by the bidder at his own cost. |
| 7.3 | Contractor should arrange for water for labour colony of their own. |
| 7.4 | BHEL shall not be responsible for any inconvenience or delay caused due to any interruption of water supply and the contractor shall claim no compensation for delay in work for such interruption. Contractor may make standby arrangement for water at their own cost. |
| 7.5 | Contractor will have to arrange for storage of water to meet the day-to-day requirement. |
| 7.6 | The availability of water (construction as well as drinking) may be limited. Contractor shall ensure that no water is wasted. In this regard the contractor shall take all necessary measure towards preservation of water. |
| **8.0** | **ELECTRICITY** |
| 8.1 | BHEL shall provide construction power free of charge at 415V level at one point within 500 Mtr from work site. Contractor has to make their own distribution arrangement to draw electricity. Overall area illumination will be provided by BHEL. However, for night working contractor should arrange illumination as and when required by them. |
| 8.2 | The bidder shall have to provide earth leakage circuit breaker at each point wherever human operated electrical drives/ T&Ps are deployed. |
| 8.3 | The power supply will be from the available grid. BHEL shall not be responsible for any inconvenience or delay caused due to any interruption of power supply/ variation in voltage level and no compensation for delay in work can be claimed by the contractor due to such non-supply on the grounds of idle labour, machinery or any other grounds. |
| 8.4 | Bidder will have to arrange sufficient illumination at their own work areas. |
| 8.5 | The contractor should ensure that the work in critical areas is not held up in the event of power breakdown. In the event of breakdown in the electric supply, if the progress of work is hampered, it will be the responsibility of the contractor to step up the progress of work after restoration of electric supply so that overall progress of work is not affected. |
| 8.6 | The contractor shall have to make arrangement at their own cost for illumination that will be required in the working area for execution of the work & safety of workmen. |
| 8.7 | Contractor shall make arrangement of electricity of their own for labour colony. |
| **9.0** | **CONSUMABLE** |
| 9.1 | All consumables, like gas, electrodes, chemicals, lubricants etc. required for the scope of work, shall be arranged by the contractor at his cost from approved brand / make unless otherwise specifically mentioned in the contract. |
| 9.2 | All consumables to be used for the job shall have to be approved by NTPC / BHEL prior to use. |

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| 9.3 | In the event of failure of contractor to bring necessary and sufficient consumables, BHEL may arrange for the same at the risk and cost of the contractor. The entire cost towards this along-with overhead shall be paid by the contractor or deducted from the contractor's bills. |
| **10.0** | **TEST CERTIFICATES** |
| | Necessary test certificates of all materials supplied by contractor are to be produced to BHEL prior to use of those materials. |
| **11.0** | **IMTE** |
| | The contractor shall ensure deployment of reliable and calibrated instrument, measuring, and test Equipment (IMTE). The IMTE shall have test calibration certificate from authorized / Govt approved agencies. The contractor shall also keep provision of alternate engagement for such IMTE so that the work does not suffer when a particular IMTE is sent for calibration. Re-testing/ re-calibration shall also be arranged by the contractor at their own cost at regular interval during the period of use as advised by BHEL. |
| **12.0** | **QUALITY CONTROL & QUALITY ASSURANCE** |
| 12.1 | **INSPECTION & FIELD QUALITY ASSURANCE** |
| 12.1.1 | Contractor shall carry out all activities conforming to the approved Field Quality Plan (FQP) & technical instructions as revised from time to time. 'Total Quality' shall be the watchword of the work and contractor shall strive to achieve the quality standards, procedures laid down by BHEL. He shall follow all the instructions as per BHEL drawings and quality standards. Contractor shall provide the services of quality assurance engineer as per the relevant clauses. |
| 12.1.2 | Preparation of quality assurance log sheets and protocols with customer / consultants / statutory authority, welding logs, NDE records, testing & calibration records and other quality control and quality assurance documentation as per BHEL engineer's instructions, is within the scope of work / specification. These records shall be submitted to BHEL / customer for approval from time to time. |
| 12.1.3 | The protocols between contractor and customer / BHEL shall be made for correctness of foundations, materials, procedures, at each stage of installation, generally as per the requirement of customer / BHEL. This is necessary to ensure elimination of errors and to avoid accumulation and multiplication of errors. |
| 12.1.4 | A daily log book (with proper indexing) should be maintained by every supervisor / engineer of contractor, for respective area of work, on the job for detailing and incorporating alignment/ clearance / centering / levelling readings and inspection details of various equipment, etc. This log book shall be always accessible to BHEL engineers.<br>High pressure welding (as applicable under the scope of this contract) details like serial number of weld joints, welders name, date of welding, details of repair, heat treatment etc. will be documented in welding log as per BHEL Engineer's instructions.<br>Record of radiography (as applicable under the scope of this contract) containing details like serial number of weld joints, date of radiography, repairs, if any, re-shots etc shall also be maintained as per BHEL Engineer's instructions.<br>Record of heat treatments (as applicable under the scope of this contract) performed shall be maintained as prescribed by BHEL. |
| 12.1.5 | The performance of welders (as applicable under the scope of this contract) will be reviewed from time to time as per the BHEL standards. Welders' performance record shall be furnished periodically for scrutiny of BHEL's Engineer. Corrective action as informed by BHEL shall be taken in respect of those welders not conforming to these standards. This may include removal/ discontinuance of concerned welder(s). Contractor shall arrange for the alternate welders immediately. |
| 12.1.6 | Only welders duly authorized by BHEL / customer / consultant after welder qualification test as per ASME Sec-Ix / AWS D1.1 (as applicable) shall be engaged on the work. All the welders shall carry identity cards as per the proforma prescribed by BHEL / Customer / Consultant. |
| 12.1.7 | Any re-laying or re-termination of cables / re-erection of instruments / recalibration of instruments etc. required due to contractor's mistake and found at any stage inspection shall be carried out by the contractor at no extra cost. Repair / rectification |

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| | procedure to be adopted to make any job acceptable shall be subject to the approval of BHEL. |
| 12.1.8 | Weekly Quality Review Meeting at site shall be organised by BHEL to discuss quality issues and next week inspection plans. Site in-charge of the contractor along with QAEs of the contractor must be present in the meeting with closure report of the issues raised by BHEL in the previous meetings. |
| **12.2** | **REQUIREMENT OF ISO 9001** |
| 12.2.1 | BHEL: PSER is accredited with ISO 9001 certification and as such this work is subject to various audits to meet ISO 9001 requirements. |
| 12.2.2 | The basic philosophy of the Quality Management System under ISO 9001 is to define the organizational responsibility, work as per documented procedures, verify the output with respect to acceptance norms, identify the non-conforming product / procedure and take corrective action for removal of non-conformance specifying the steps for avoiding recurrence of such non-conformities, & maintain the relevant quality records. The non-conformities are to be identified through the conduct of periodical audit of implementation of quality systems at various locations/stages of work. Suppliers / vendors of various products / services contributing in the work are also considered as part of the quality management system. As such the contractor is expected not only to conform to the quality management system of BHEL but also it is desirable that they themselves are accredited under any quality management system standard. |
| 12.2.3 | BHEL reserves the right to carry out quarterly quality audits and quality surveillance of the systems and procedures of contractor's quality management. Contractor shall provide all necessary assistance to enable BHEL to carry out such audit & surveillance. |
| 12.2.4 | Quality audits / approval of the results of test & inspection will not prejudice the right of BHEL to reject an equipment service not giving desired performance and shall not in no way limit the liabilities and responsibilities of the contractor in earning satisfactory performances of equipment / service as per specification. |
| **12.3** | **MMEs / MMRs** |
| 12.3.1 | Contractor shall ensure deployment of reliable and calibrated MMEs (Measuring and Monitoring Equipment). The MMEs shall have test / calibration certificates from authorised / Government approved / Accredited agencies traceable to National / International Standards. Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer within the contract price. The contractor will also have alternate arrangements for such MMEs so that work does not suffer when the particular equipment / instrument is sent for calibration. Also if any MMEs not found fit for use, BHEL shall have the right to stop the use of such item and instruct the contractor to deploy proper item and recall i.e. repeat the readings taken by that instrument, failing which BHEL may deploy MME and retake the readings at Contractor's cost. |
| 12.3.2 | Contractor shall provide all the Measuring Monitoring Equipment (MMEs) required for completion of the work satisfactorily. These MMEs shall be of brand, quality and accuracy specified by BHEL Engineer and should have necessary calibration and other certificates as per the requirement of BHEL Engineer. Decision of BHEL Engineer regarding acceptance or otherwise of the measuring instruments / gauges / tools for the work under this specification, is final and binding on the contractor. BHEL shall give an indicative list of MMEs required for this work else where in this contract and to be made available by the contractor. The list will be reviewed by BHEL site as per the requirement of approved FQPs and the contractor shall meet any augmentation needed wherever required. |
| 12.3.3 | It is the responsibility of the contractor to prove the accuracy of the testing / measuring / calibrating equipment brought by him based on the periodicity of calibration as called for in the BHEL's quality assurance standards/BHEL Engineer's instructions. |
| 12.3.4 | Re-work necessitated on account of use of invalid MMEs shall be entirely to the contractor's account. He shall be responsible to take all corrective actions, including resource augmentation if any, as specified by BHEL to make-up for the loss of time. |
| 12.3.5 | In the courses of erection, it may become necessary to carry repeated checks of the |

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| | work with instruments recently calibrated, re-calibrated. BHEL may counter / finally check the measurements with their own MMEs. Contractor shall render all assistance in conduct of such counter / final measurements. | | | |
| **12.4** | **INSPECTION BY TS / FES / QA ENGINEERS OF BHEL UNITS / ENGINEERING CENTRES** | | | |
| 12.4.1 | Apart from day-to-day inspection by BHEL Engineers stationed at Site and Customer's Engineers, stage inspection of equipment under erection and commissioning at various stages may also be conducted by teams of Engineers from Field Engineering Services of BHEL's Manufacturing Units, Quality Assurance teams from Field Quality Assurance, Unit/Factory Quality Assurance and Commissioning Engineers from Technical Services etc. Contractor shall arrange all labour, tools and tackles etc along with proper access for such stage inspections free of cost. | | | |
| 12.4.2 | Any modifications suggested by BHEL FES and QA Engineers' team shall be carried out. Claims of contractor, if any, shall be dealt as per applicable clause of the contract, and provided such modifications have not arisen for reasons attributable to the contractor. | | | |
| **12.5** | **PENALTIES ON VENDORS / SUB-CONTRACTORS AGAINST NON-COMPLIANCE OF QUALITY NORMS** | | | |
| **Sl. No.** | **Nature of Non-compliance** | **Penalty for Domestic Project** | **Penalty for Export Project** | **Remarks** |
| GENERAL | | | | |
| 12.5.1 | Unavailability of QAE deployment schedule (duly approved by BHEL Site) matching with manpower requirement of approved L2 schedule | 0.10% | 0.10% | Against each RA bill |
| 12.5.2 | Unavailability of required number of QAE with proper experience & NDT certification as per the requirement of the Contract | Rs. 1,000.00 | $16.00 | Per person per day |
| 12.5.3 | Not attending quality meeting of BHEL by nominated member of vendor / sub-contractor | Rs. 2,000.00 | $32.00 | Per meeting |
| CALIBRATION | | | | |
| 12.5.4 | Use of MMEs without valid calibration certificate | Rs. 1,000.00 | $16.00 | Per equipment per instance |
| 12.5.5 | Use of NDT equipment, welding equipment without having valid calibration certificate / condition not as per requirement | Rs. 1,000.00 | $16.00 | Per equipment per instance |
| WELDING & NDT | | | | |
| 12.5.6 | Unqualified welders carrying out welding / tack welding | Rs. 1,000.00 | $16.00 | Per welder per instance. (Gatepass of the person shall be withheld) |
| 12.5.7 | Not using portable oven for welding consumables | Rs. 500.00 | $8.00 | Per welder per instance. (The consumables in the oven shall be confiscated) |

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| 12.5.8 | Not using electrodes pre-baked in baking oven | Rs. 500.00 | $8.00 | Per instance. (The subject consumables shall be confiscated) |
| 12.5.9 | Not using welding consumables of approved make & not using correct type of electrode as per approved EWS / Drawing / WPS | Rs. 1,000.00 | $16.00 | Per instance. (The subject consumables shall be confiscated) |
| 12.5.10 | Non-removal of welding slag and spatters after welding | Rs. 500.00 | $8.00 | Per joint |
| 12.5.11 | Not using NDT equipment as prescribed in the manual / FQP / guidelines / Contract | Rs. 1,000.00 | $16.00 | Per equipment per instance |
| 12.5.12 | Welder doing welding without valid job card | Rs. 500.00 | $8.00 | Per instance |
| 12.5.13 | Discrepancy observed in the weld joints identified by BHEL / Customer for RT vs RT film offered | Rs. 2,000.00 | $32.00 | per joint |
| MATERIAL MANAGEMENT | | | | |
| 12.5.14 | Non-maintenance of grid pillar marking | Rs. 200.00 | $3.00 | Per location week |
| 12.5.15 | Mismatch of location of material in store area w.r.t. location mentioned in stock register | Rs. 500.00 | $8.00 | Per instance |
| 12.5.16 | Non-compliance of Preservation of material as per storage & preservation manuals | Rs. 1,000.00 | $16.00 | Per equipment |
| 12.5.17 | Not offering received material for verification within stipulated time as per contract | Rs. 500.00 | $8.00 | Per instance |
| PAINTING & ALLIED WORKS | | | | |
| 12.5.18 | Not using primer / paints of approved make and as per Specifications | Rs. 1,000.00 | $16.00 | Per instance |
| 12.5.19 | Painting without proper surface preparation as per approved schedule / drawing / FQP | Rs. 500.00 | $8.00 | Per instance |
| PROTOCOLS & LOG SHEETS | | | | |
| 12.5.20 | Delay in preparation of Protocols / Logsheets as per approved FQP within 3 days of completion of checks | Rs. 200.00 | $3.00 | Per protocol per day delay |
| INSPECTION OF BOUGHT-OUT ITEMS / CONSUMABLES | | | | |
| 12.5.21 | Delay in offering inspection of Bought-out Items / Consumables / Aggregates (for items which need site | 1% of the item value of the LOT | 1% of the item value of the LOT | per item per day delay after receipt of material |

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| | inspection as per approved QP) within 3 days of receipt of material at site | | | |
| 12.5.22 | Delay in submission of required documents (viz. Invoice, Inspection Release Note, COC, MDCC, MTC as the case may be) of Bought-out Items (shop inspection items / consumables) with in 3 days of receipt of material at site. | 1% of the item value of the LOT | 1% of the item value of the LOT | per item per day delay after receipt of material |
| **NOTE:**<br>Any non-conformity requiring dismantling / rework, attributable to vendor / sub-contractor, shall be penalised at a rate mentioned above or cost to BHEL, which ever is higher. | | | | |
| **13.0** | **OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT** | | | |
| | Vendor has to follow HSE norms at project site during execution of entire contract period and the applicable HSE norms are noted in Tender Docurnent for HSE norms having Document Title: Health, Safety and Environment Plan for Site Operation by Subcontractors | | | |
| **14.0** | **PROJECT MANAGEMENT/ CONSTRUCTION MANAGEMENT** | | | |
| | To meet the need of construction management at site, contractor shall provide the following services within quoted/ accepted rates. | | | |
| 14.1 | PLANNING & MONITORING | | | |
| 14.1.1 | The bidder shall prepare detail construction schedule (L-3) as per completion dates given in this document. This schedule must include all milestone and key activities for each sub-system / component in the areas of engineering (wherever applicable), procurement, manufacture (wherever applicable), excavation/ construction/ erection. This network must conform to the overall project schedule. The bidder should also ensure monitoring of these activities at least weekly basis to start with and on daily basis whenever required by BHEL. | | | |
| 14.1.2 | The bidder shall also prepare progress report indicating progress on key activities, management summary for critical activities, list of actions requiring attention of BHEL. This schedule is to be preferably made in PRIMAVERA/MS PROJECTS, so that the same is compatible with BHEL's project management software. | | | |
| 14.1.3 | The bidder will have to install 1 no PC (multimedia PC work station Pentium- core-i5-650, 3.2 GHZ or above, 500 GB HDD, 6 GB RAM, 100/1000 MBPS LAN card) of HP/ DELL / HCL /LENEVO or equivalent make with window 10 (professional) 64 bit (with roll back to 32 bit O/S and required software like MS Office 2010 Professional or higher, AutoCAD 2014 or higher, PageMaker (7.0 etc), ADOBE PDF CREATOR with one no laser jet printer compatible for A4 size printing (ink/ cartridge for which to be supplied as and when required) with power backup at places, as per instruction of BHEL for exclusive use of BHEL.<br><br>These computers / printers shall remain contractor's property and they will be allowed to take out the same after completion of contract period. The contractor shall provide data / information etc in prescribed formats for periodical updating of the progress reports, material management reports, updating of network pertaining to the contractor's scope of work etc.<br><br>The contractor shall also provide 1 (one) no computer operator and 1 (one) number service staff for miscellaneous service for BHEL's use at site / Kolkata for reconciliation, progress review & day-to-day planning purpose, documentation etc. These facilities are to be provided within 30 days from LOI date till completion of scheduled contract period (Refer clause no 3.9 above).<br><br>If contractor fails to provide computer / printer / personnel as per requirement, for a | | | |

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| | continuous period of fifteen days or more, BHEL shall have the right to deduct the amount as per following rates on prorate basis, from contractor's RA bill or any other dues. |
| 14.1.3.1 | @ Rs 20,000/- (Twenty thousand)/ month for each computer operator. Or at actuals (rate +30%) if BHEL arranges this facility, whichever is lower. |
| 14.1.3.2 | @ Rs 15,000/- (Fifteen thousand) / month for each service staff. Or at actuals (rate +30%) if BHEL arranges this facility, whichever is lower. |
| 14.1.3.3 | @ Rs 15,000/- (Fifteen thousand)/ month for each set of computer & printer. Or at actuals (rate +30%) if BHEL arranges this facility, whichever is lower. |
| 14.1.3.4 | In the event of the contract period getting extended beyond the stipulated time for reasons not attributable to you, above services may either be withdrawn or retained as per instruction of BHEL. If services are retained, you will be reimbursed at the above mentioned rate or (actual +15%), whichever is lower, if the services of operator / service staff are being used by BHEL. |
| 14.1.3.5 | The contractor's site office must have facilities of communications like Fax, E-mail, and telephone with STD facility within a month from LOI. However, if successful bidder decides not to install Fax at site then Suitable scanner may be made available for sending scanned documents through email as alternate to Fax. |
| 14.1.4 | A list contain supply of computers & printers with their workability status and details of supply of computer operators & service staff with their payment details will be quarterly submitted by the successful bidder to BHEL. |
| 14.1.5 | A list contain supply of computers & printers with their workability status and details of supply of computer operators & service staff with their payment details will be quarterly submitted by the successful bidder to BHEL. |
| 14.2 | PROGRESS REPORTING |
| 14.2.1 | The bidder shall submit daily, weekly and monthly progress reports for work force, materials reports, consumables (gases / electrodes) report and other reports as per pro-forma considered necessary by the BHEL. In case of any failure on contractor's part to comply with this, BHEL may at its discretion, consider to withhold part payment against their RA bills. |
| 14.2.2 | The progress report shall indicate the progress achieved against planned with reasons indicating delays, if any, and shall give the remedial actions which the contractor intends to take to make good the slippage or lost time, so that further works again proceed as per the original program and the slippages do not accumulate and effect the overall program. |
| 14.2.3 | The daily work force reports shall clearly indicate the work force deployed, category-wise specifying also the activities in which they are engaged. |
| 14.2.4 | Weekly progress review meetings will be held at site during which actual progress during the week vis-à-vis scheduled program shall be discussed or actions to be taken for achieving targets. For discussions, the contractor shall present program of subsequent week. The contractor shall constantly update/revise his work program to meet the overall requirement. |
| 14.2.5 | Periodic progress reviews on the entire activities of execution in respect of supply and works in scope of bidder will be held once in a month at Kolkata /site. These meetings will be attended by reasonably higher officials of the contractor and will be used as a forum for discussing all areas where progress needs to be speeded up. The contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings. |
| 14.2.6 | During construction contractor shall take an average Twenty colour digital photograph / slides each month (not less than four per week) of the works during progress through email only. However, if required, bidder to submit hard copies of photographs as and when required in line with instruction by BHEL site.<br>In case of failure in providing such photograph in each month, an amount of Rs. 10,000/- per month shall be deducted from contractor's RA bill. |
| 14.2.7 | Successful bidder has to provide for electronic / computerized storing and re-production/ printing/ plotting of various data, log sheets, protocols, measurements etc. These may be stored in pen drive (as per requirement) and handed over to BHEL as per requirement. |

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| 14.3 | SITE ORGANIZATION | |
| 14.3.1 | The contractor shall maintain a site organization of adequate strength in respect of manpower, construction machinery and other implements at all time for smooth execution of the contract headed by a competent construction manager for site operations with sufficient level of authority to take site decisions. The vendor will submit organization chart (showing the name of SITE-IN-CHARGE) with individual bio-data indicating various levels of experts to be posted for supervision in the fields of supervision and execution, quality, material management, planning, safety, etc. The organization shall be reinforced from time to time, as required to make up slippage (if any) from the schedule without any commercial implication to BHEL. The organization chart is to be submitted within 10 days from the date of LOI. | |
| 14.3.2 | Following (minimum) engineering manpower with power plant construction background to be deployed at site by the successful vendor for their day to day supervision etc.as directed. | |
| 14.3.2.1 | Qualified safety officer (exclusive for safety supervision) | One no. officer (from start of work)<br>One no. assistant (from start of work) |
| 14.3.2.2 | Site supervising staff for Civil work | Minimum 2 no. engineers and 4 no. supervisors with two shift incharges during shell construction. |
| 14.3.2.3 | Site supervising staff for Structural work | One no. engineer and Minimum 2 nos. supervisors |
| 14.3.2.4 | Engineer for quality inspection. | Minimum Two nos. (one no. from start of work, 2nd as per site requirement) |
| 14.3.2.5 | Material management, site enabling | One no. |
| 14.3.2.6 | Enginner for Civil Laboratory | One no. |
| 14.3.3 | Deputation of above man-power shall be jointly decided at site in line with construction schedule. | |
| 14.3.4 | Engineer / supervisor for other functions like store & purchase, material management, planning, fin, admn etc are to be provided as per site requirement and not considered above. | |
| 14.3.5 | In the event of non deputation of engineer / supervisor by the bidder as per above agreed schedule, BHEL shall reserve the right to deduct Rs 60,000.00 per man-month for engineer and Rs 40,000.00 per man-month for the supervisor / safety officer from RA bills. Further induction of manpower, regarding site supervisor & site engineer will be decided at site as per requirement without any financial implication. | |
| 14.3.6 | BHEL reserves the right to reject or approve the list of personnel proposed by the contractor. The persons whose bio-data have been approved by BHEL will have to be posted at site and deviation in this regard will not be permitted unless specific & reasonable justification is made. | |
| 14.3.7 | In addition to above, a well experienced qualified engineer to be designated, as 'Project Co-cordinator', shall be deployed by the contractor. Such engineer shall have adequate exposure on the job and shall remain fully involved in all planning activities, guidance etc to contractor's own team during the complete execution period of contract. | |
| 14.3.8 | The contractor should also submit to BHEL for approval a list of T&Ps along with their fitness certificates. The tools & tackles shall not be removed from site without written permission of BHEL. | |
| 14.3.9 | The contractor should also submit network programs for the erection of various items. These networks shall show the NTPC / BHEL hold points, which have to be cleared by NTPC / BHEL, or their authorized representatives before further erection can take place. These programs for the erection would clearly identify responsibilities of the contractor and NTPC / BHEL. It is the responsibility of the contractor to get the Networks approved by BHEL within four weeks of the date of finalization of award of work/ placement of LOI. | |
| 14.4 | CONSTRUCTION MANAGEMENT | |
| 14.4.1 | Based on the approved program, the contractor shall submit a program of construction / erection / commissioning for the implementation. These programs would be amplified showing start of erection and subsequent activities and shall form the basis for site | |

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| | execution and detail monitoring. The three-monthly rolling program with the first month's program being tentative based on the site condition would be prepared based on these programs. The contractor shall also be involved along with NTPC / BHEL to tie up detailed resources mobilization plan over the period of the contract matching with the performance targets. |
| 14.4.2 | The program would be jointly finalized by the site in-charge of the contractor with BHEL / NTPC's project coordinator as well as the site-planning representative. The erection program will also identify sequential events matching financial turnover. |
| 14.4.3 | Theses network / Program must confIrm to the overall requirement of the project schedule. The bidder should also ensure monitoring of these activities at least on weekly basis to start with and on daily basis whenever required by BHEL. |
| 14.4.4 | The contractor is liable to furnish all documentary evidences towards payment of Works Contract Tax as and when required by BHEL. |
| **15.0** | **TEST CERTIFICATE FOR T&P** |
| | All T&P, lifting tackles and pulling devices to be deployed by the contractor must bear valid / latest test certificates for their suitability, and the documents shall be preserved at site. |
| **16.0** | **T&P TO BE PROVIDED BY BHEL** |
| | No T&P shall be provided by BHEL. |
| **17.0** | **MATERIAL HANDLING (BHEL ISSUED MATERIAL)** |
| 17.1 | Ready Mix Concrete, Reinforcement (TMT bar), structural steel (MS plates, ISMB, ANGLE, CHANNEL, Chequred plate, Stainless Steel Plate / liner) for site fabrication only, Borosilicate Glass Blocks, required adhesives / membrance and primer for installation of Borosilicate Glass Block only will be issued free of cost by BHEL for use in the work covered in this contract. All other materials required for proper completion of job shall be provided by contractor and quoted rates shall be inclusive of this. |
| 17.2 | Consignment of steel will be directly issued to the contractor as received by BHEL, on weighment basis from its supplier, as per delivery challan of supplier. Borosilicate Glass Blocks, required adhesives / membrance and primer for installation of Borosilicate Glass Block may be issued directly as received from supplier or from BHEL Store. Ready mix Concrete will be issued as per clause 3.2 of scope of work. |
| 17.3 | Handling of all steel, Borosilicate Glass Blocks, required adhesives / membrance and primer for installation of Borosilicate Glass Block of total project will be in vendor's scope for which no separate payment will be given by BHEL. |
| 17.4 | It would be the responsibility of the contractor to keep in constant contact with BHEL / site to find out the delivery status, arrival of the consignments and arrange for escort to accompany the truck/ trailor for transportation of above materials by BHEL's supplier, as necessary. The lorry, truck way bill for the consignment as shall be received by BHEL would be handed over to the contractor immediately for unloading of materials including all arrangement for necessary gate passes etc. All arrangement for necessary gate passes etc shall be the responsibility of contractor. |
| 17.5 | Payment of all demurrages that may result due to contractor's fault/ delay would be the responsibility of the contractor. If BHEL have to make payment of demurrage together with freight, the amount so paid as demurrages for the reasons stated above, shall be recovered from the bills of the contractor. The decision of BHEL's engineer in this regard will be final and binding on the contractor. However, the contractor has to clear all such charges, if any in this regard and complete the job without waiting for BHEL's decision. |
| 17.6 | It would be the responsibility of the contractor to sign on the delivery book acknowledgement slip of supplier / transport authorities etc. |
| 17.7 | Consignments coming on Sundays and holidays are also required to be handled/ unloaded by the contractor. Since the offices and stores will probably remain closed on such days, it will be the responsibility of the contractor to contact BHEL engineers at their residence and obtain instructions. |
| 17.8 | Since the consignments are expected to arrive during any time of the day or night, contractor shall have, his workmen round the clock at site as well as other places as required to unload the materials immediately on arrival. |
| 17.9 | Unloading of materials at the covered srore, storage yard or at places designated by |

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| | BHEL, stacking & restacking, shifting & resifting, using contractor's own cranes, trailers and other equipments with the valid road permit for their operation, unloading and stacking etc shall be responsibility of the contractor under this contract. All materials shall be stacked, stored above ground level by use of concrete or wooden sleepers. No materials shall remain on ground at any time. All concrete sleepers required for stacking the materials shall be arranged by contractor (successful bidder). All other material handling equipments like winches, d-shackles, slings of various sizes, max puller, pulley blocks, jacks, trucks, tailors etc required for such material handling of steel etc shall be arranged by contractor within quoted / accepted rates. |
| 17.10 | It will be the responsibility of the contractor to submit computerized account of all such consignments of materials received by them, daily to BHEL. |
| 17.11 | BHEL reserve the right to recover from the contractor any loss arising out of damage / theft or any other causes of the materials issued to him at any point of time. |
| 17.12 | Open land (very limited space) for storage shall be provided by BHEL on free of cost basis. Temporary barbed wire fencing of the steel storage yard, batching plant area, reinforcement bending yard area etc are to be done by the contractor as per BOQ items and is included under the scope of his work. Contractor shall also remove grass, bushes, trees etc wherever required off the land provided to him and shall make proper continuous up-keepment of the open yard/ land by removing grass, bushes trees etc and same is included under the scope of his work & no extra payment shall be made to the contractor in this regard. The bidder shall make complete arrangement of necessary security personnel, to safeguard all free issue materials in his custody. Materials issued will be used only for construction of permanent work. The contractor shall take care of material issued by BHEL and shall protect the same from theft, damage and weathering. |
| 17.13 | The contractor shall construct waterproof covered store for Borosilicate Glass Blocks, Adhesives / membrance and Primer Paint. CGI/ asbestos roofing (slope) with brick masonry wall, PCC flooring. Materials required for the same shall be provided by contractor at his own cost. Stacking of materials is to be done as per IS codes or manufacturer / supplier recommendation with proper illumination and locking arrangements. Storing of material in controlled temperature is also in successful bidder's scope within the quoted rate. |
| 17.14 | The contractor shall in no case be entitled for any compensation or damages on account of any delay in supply or non-supply thereof for all or any such material. |
| 17.15 | Rusting of steel, damage of packing of Borosilicate lining materials must be avoided. In case, due to any cause attributable to the contractor, such rusting of steel occur rendering the same unusable, damage of Borosilicate lining materials, then such cost of materials shall be recovered from the interim payment at the penal rate specified in the tender. |
| 17.16 | No material shall be issued to the contractor except as those indicated above, i.e. Ready-mix Concrete, steel, Borosilicate Glass Blocks, required adhesives / membrance and primer unless otherwise expressly provided for in the contract. Contractor will have to make his own arrangement at his own cost for procurement of any other material as required for the works and of such quality as acceptable to BHEL. |
| 17.17 | The contractor shall maintain proper store account for all the BHEL issued materials and shall give monthly computerised reconciliation statement of such account to the BHEL. |
| 17.18 | Contractor shall carry out in complete association with BHEL, material management functions and execution like day to day update of materials, issued to contractor, accounting for surplus / scrap material returned etc. These functions shall also be carried out through computerised system utilizing suitable software. Contractor shall provide experienced software personnel to associate on dedicated basis for efficient discharge of the same. |
| 17.17 | The contractor shall solely be responsible for the safety & quality of material after it is handed over and issued to contractor by BHEL. |
| 17.18 | BHEL issued materials shall not under any circumstances taken out of the project site unless otherwise permitted by BHEL. |

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| 17.19 | All the necessary lifting tackles, cranes, hydra, tools & plants including tractors, trailers, trucks, pulley blocks, jacks, winches, wire ropes etc, of suitable capacities and other equipments incidental to carry out this work shall have to be arranged by the contractor at his cost. BHEL engineer reserves the right to inspect lifting tackles and equipment before allowing their use. Such approval however shall not relieve the responsibility of the contractor to ensure safe handling of equipment taking the precautions to avoid any accident and damage to other equipment and personnel. |
| 17.20 | No separate payment will be applicable for the above job. The contractor will quote the rate for the items inclusive of all charges for the above job. The contractor shall organise despatch & transport steel materials through supplier and unload & receive the materials as above as per requirement decided by BHEL and in this case the decision of BHEL will be final. |
| 17.21 | Bidder's scope of handling of steel under the scope of this tender includes stacking / storing of materials over concrete sleepers. Bidder scope shall include provision of concrete sleepers for this purpose and no separate payment against the same will be made by BHEL. After completion of the job bidder shall take back the sleepers. Bidder's quoted rate/ price shall be in consideration to this. |
| **18.0** | **ISSUE OF MATERIALS** |
| 18.1 | ISSUE OF READY MIX CONCRETE |
| 18.1.1 | Bidder has to give a receipt of quantity of Ready Mix Concrete at the time of taking of concrete at batching plant. For ensuring quantity, bidder may check the print out of concrete from batching plant. |
| 18.1.2 | The contractor shall submit to the engineer, a statement indicating estimated quantity of Ready Mix Concrete required at least two months in advance. In addition, the contractor shall also furnish the estimated requirement of Ready Mix Concrete during next month by the third week of the current month, failing which BHEL will not responsible to ensure supply of Ready Mix Concrete. Delay in completion if any for the same shall be in bidders account. |
| 18.2 | ISSUE OF STEEL |
| 18.2.1 | The steel shall be issued to the contractor free of cost on the following basis. |
| 18.2.1.1 | MS structural steel (MS plates, ISMB, ANGLE, CHANNEL, Chequred plate, Stainless Steel Plate/liner) materials – Weighment basis (unit – MT). |
| 18.2.1.2 | Reinforcement steel and earthing rod (MS round) – Weighment basis (unit – MT). |
| 18.2.2 | All the steel (Reinforcement, MS plates, ISMB, ANGLE, CHANNEL, Chequred plate, Stainless Steel Plate/liner) issued by BHEL shall be properly accounted for. The total quantity of steel required for the work will be calculated from the approved Bar Bending schedule, fabrication drawings, approved laps, chairs and lugs. The measurement for payment as well as for accounting shall be based on the sectional weights as indicated in the following IS specifications.<br>IS: 808-1989 - Beams, channels and angles<br>IS: 1730-1961 - Plates<br>Reinforcements - Fe-500 confirming to IS: 1786. or grade-1 of IS:432 (part-I) |
| 18.2.3 | In case any such sectional weights are not available in the above documents, the manufacturer recommendation shall be binding. |
| 18.2.4 | The steel issued to the contractor shall be mainly in standard length and sections as received from the supplier. However, the contractor shall be bound to accept the steel in length as available in the project stores no claims for extra payment because of issue of non-standard length will be entertained. |
| 18.2.5 | MS flats as required are to be arranged by the contractor as per BOQ items. |
| 18.3 | ISSUE OF BOROSILICATE GLASS BLOCK |
| | Borosilicate Glass block shall be issued as received vide challan of the transporter in sqm worked out by multiplication of block sizes by no of block. |
| 18.4 | ADHESIVES / MEMBRANCE |
| | Shall be issued in Kg / Litre as received in drum |
| 18.5 | PRIMER PAINT |
| | Shall be issued in Litre as received in drum |
| 18.6 | The contractor shall satisfy himself of the quality and quantity of the materials at the time of taking delivery from BHEL stores. No claims whatsoever will be entertained by |

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| | BHEL because of quality or quantity after the materials are taken by contractor from BHEL stores. |
| 18.7 | The contractor shall submit to the engineer, a statement indicating estimated quantity of cement, steel, Borosilicate Glass Blocks, required adhesives / membrance and primer required at least two months in advance. In addition, the contractor shall also furnish the estimated requirement of cement and steel during a month by the third week of the previous month indicating his requirement. |
| 18.8 | Bidders to ensure that no lamination materials are taken over by them from BHEL. Fabrication wastage, if any due to above, shall not be compensated by BHEL |
| 18.9 | Bidder to note that all fasteners like MS/ HT/ HSFG bolts/ nuts, lock nuts, washers etc shall be supplied by the bidder as per applicable item of Price Schedule. |
| 18.10 | Bidder to note that cement and steel required for his enabling job like store/ site office etc shall be arranged at his own cost. |
| **19.0** | **RETURN OF MATERIALS** |
| 19.1 | RETURN OF READY MIX CONCRETE |
| 19.1.1 | Under any circumstances, Ready Mix Concrete will not be taken back. Bidder to plan accordingly for proper use of Ready Mix Concrete. |
| 19.2 | RETURN OF STEEL INCLUDING SCRAP |
| 19.2.1 | All surplus steel and all wastage materials will be taken back on weighment basis. |
| 19.2.2 | Surplus, unused and un-tampered steel shall be sorted section-wise and returned separately for a place directed by BHEL/ engineer within the project area. Return of such materials will not be entitled to any handling and incidental charges. |
| 19.2.3 | All wastage/ scrap (including wastage, unusable scrap) shall be returned to the stores on weighment basis and a receipt obtained for material accounting purposes. Return of such material will not be entitled to any additional cost due handling and transportation and incidental charge. |
| 19.2.4 | Scrap for reinforcement steel and structural steel shall be returned separately as per instruction of BHEL. |
| 19.3 | BOROSILICATE GLASS BLOCK |
| | All unused Borosilicate blocks shall be taken back by BHEL in sqm worked out by multiplication of block sizes by no. of block |
| 19.4 | ADHESIVES / MEMBRANCE |
| | All unused untampered adhesive / membrane drum shall be taken back by BHEL in Kg as received during issue. Open drum / partially used drum shall not be taken back |
| 19.5 | PRIMER PAINT |
| | All unused untampered drum containing paint shall be taken back by BHEL in litre as received during issue. Open drum / partially used drum shall not be taken back |
| **20.0** | **MATERIAL CONSUMPTION AND WASTAGE** |
| 20.1 | READY MIX CONCRETE CONSUMPTION |
| 20.1.1 | The theoretical consumption of various grade of based on approved construction drawing. Quantity shall be calculated considering the volume of concrete as per approved drawing. No extra cost shall be payable to the contractor for any deviation in quantity of Ready Mix Concrete received from the Batching Plant and actual use at site. |
| 20.2 | READY MIX CONCRETE WASTAGE |
| 20.2.1 | Allowable wastage: One point five percent (+1.5%) of the theoretical consumption shall be considered as allowable wastage. |
| 20.3 | REINFORCEMENT STEEL & EARTHING MS ROUND CONSUMPTION |
| 20.3.1 | The theoretical consumption of various diameter of reinforcement and earthing MS round shall be based on approved construction drawing and bar bending schedule. Weight shall be calculated considering the sectional weights as per Indian standards. No extra cost shall be payable to the contractor for any deviation in weights for the different procedures adopted for issue and calculation of the theoretical consumption including rolling tolerances. |
| 20.3.2 | Actual consumption = Issue – Surplus. |
| 20.3.3 | Surplus = Un-tampered and unused quantity of steel returned by the contractor to BHEL store along-with relevant documents. |

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| 20.3.4 | Wastage = Actual consumption – Theoretical consumption. | | |
| 20.4 | REINFORCEMENT STEEL & EARTHING MS ROUND WASTAGE | | |
| 20.4.1 | Allowable wastage – (+3%) of the theoretical consumption shall be considered as allowable wastage. | | |
| 20.4.2 | Wastage and scrap shall be as per actual weighment basis. | | |
| 20.4.3 | Sl no | Reinforcement steel & earthing rod 40 mm ms round | Basis of issue & penal recovery |
| | R-1 | Theoretical consumption (without considering wastage and scrap or loss) | Free |
| | R-2a | Wastage limited to plus three percent (+3%) of aforesaid theoretical consumption (R-1) towards allowable wastage and return to BHEL Store. | Free |
| | R-2b | Wastage limited to plus three percent (+3%) of aforesaid theoretical consumption (R-1) towards allowable wastage but not returned to BHEL Store. | Penal rate |
| | R-3 | Wastage beyond three percent (+3%) of the theoretical consumption above (R-1). | Penal rate |
| 20.5 | STRUCTURAL STEEL CONSUMPTION | | |
| 20.5.1 | The theoretical consumption of various sections shall be based on approved drawings. Weights shall be calculated considering the sectional weights as per Indian standard as mentioned in relevant clause. No extra shall be payable to the contractor for any deviation in weights for the two different procedures adopted for issue and calculation of the theoretical consumption including rolling tolerances. | | |
| 20.5.2 | Actual consumption = Issue – Surplus. | | |
| 20.5.3 | Surplus = Untempered, unused, uncut quantity of steel returned by the contractor to BHEL store. | | |
| 20.5.4 | Wastage = Actual consumption – Theoretical consumption. | | |
| 20.6 | STRUCTURAL STEEL WASTAGE | | |
| 20.6.1 | Allowable wastage – 4 % (four percent) of the theoretical consumption shall be considered. Wastage is further classified as cut pieces and scrap measured as per actual weightment basis. Invisible wastage (loss of materials due to gas cutting, straightening of edges etc) shall be limited to 0.5 % (zero-point five percent) of theoretical consumption and shall be considered for reconciliation purposes only. But this invisible wastage shall be considered to be included in allowable wastage. | | |
| 20.6.2 | Sl no | Structural steel materials | Basis of issue & penal recovery |
| | S-1 | Theoretical consumption (without considering any wastage, scrap or loss) as per specification & drg. | Free |
| | S-2a | Wastage limited to plus three-point five percent (+3.5% excluding invisible wastage) of the aforesaid theoretical consumption (S-1) towards allowable wastage and return to BHEL Store. | Free |
| | S-2b | Wastage limited to plus three-point five percent (+3.5% excluding invisible wastage) of the aforesaid theoretical consumption (S-1) towards allowable wastage but not returned to BHEL Store. | Penal rate |
| | S-3 | Wastage beyond four percent (4%) of the aforesaid theoretical consumption (S-1). | Penal rate |
| 20.7 | All wastage reinforcement, MS round (for earthing), structural steel shall be returned to BHEL. | | |
| 20.8 | BOROSILICATE GLASS BLOCK | | |
| 20..8.1 | Wastage shall be controlled by Supplier of Borosilicate Glass Lining materials under the supervision of whom the lining work shall be carried out. Bidder to follow the instruction of Supplier. Wastage, even after compliance to instructions of supplier, if any, will not be considered under<br>successful bidder's account. However, if it is estabilished during the exectution that wastage is due to non-compliances by the successful bidder vis-a-vis instruction of supplier and due to the same BHEL has to procure the additional material then the | | |

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| | additional cost with applicable overhead including Taxes & duties shall be recovered from the Successful Bidder. | |
| 20.9 | ADHESIVES / MEMBRANCE | |
| 20.9.1 | Wastage shall be controlled by Supplier of Borosilicate Glass Lining materials under the supervision of whom the lining work shall be carried out. Bidder to follow the instruction of Supplier. Wastage, even after compliance to instructions of supplier, if any, will not be considered under successful bidder's account. However, if it is estabilished during the exectution that wastage is due to non-compliances by the successful bidder vis-a-vis instruction of supplier and due to the same BHEL has to procure the additional material then the additional cost with applicable overhead including Taxes & duties shall be recovered from the Successful Bidder. | |
| 20.10 | PRIMER PAINT | |
| 20.10.1 | Wastage shall be controlled by Supplier of Borosilicate Glass Lining materials under the supervision of whom the lining work shall be carried out. Bidder to follow the instruction of Supplier. Wastage, even after compliance to instructions of supplier, if any, will not be considered under successful bidder's account. However, if it is estabilished during the exectution that wastage is due to non-compliances by the successful bidder vis-a-vis instruction of supplier and due to the same BHEL has to procure the additional material then the additional cost with applicable overhead including Taxes & duties shall be recovered from the Successful Bidder. | |
| **21.0** | **RECONCILIATION OF BHEL ISSUED MATERIALS** | |
| 21.1 | The contractor shall submit a reconciliation statement of RMC, cement, steel, Borosilicate Glass Blocks, required adhesives / membrance and primer issued to him with each RA bill. | |
| 21.2 | At the time of submission of bills, the contractor shall properly account for the material issued to him as specified herein to the satisfaction of BHEL certifying that the balance materials are available with contractor’s custody at site. | |
| 21.3 | At the time of submission of bills by the contractor, if it is noticed by BHEL that the wastage is high and calls recovery at the penal rate, then BHEL will proceed for recovery for the excess wastage as per penal recovery rates as specified. | |
| 21.4 | The approved drawings/ bar bending schedules are to be considered for the purpose of reconciliation of materials. | |
| **22.0** | **RECOVERY OF MATERIAL** | |
| 22.1 | If wastage exceeds the specified limit, the recovery of excess wastage shall be made from monthly RA bill at the penal rate stipulated below. | |
| 22.2 | PENAL RATE OF MATERIALS | |
| | Item | Penal rate |
| 22.2.1 | Ready Mix Concrete | |
| | M - 7.5 | Rs 6,500 per Cum |
| | M - 10 | Rs 7,000 per Cum |
| | M - 15 | Rs 7,850 per Cum |
| | M - 20 | Rs 8,600 per Cum |
| | M - 25 | Rs 8,700 per Cum |
| | M – 30 | Rs 8,900 per Cum |
| | M - 35 | Rs 12,300 per Cum |
| | M - 40 | Rs 12,600 per Cum |
| 22.2.2 | Reinforcement steel and MS rod etc. | Rs 75,000/- per MT. |
| 22.2.3 | Stainless Steel Plate / Liner | Rs 400,000/- per MT |
| 22.2.4 | Structural steel materials. | Rs 80,000/- per MT. |
| **23.0** | **CONSTRUCTION OF TEMPORARY OFFICE, STORES ETC** | |
| 23.1 | The contractor shall arrange at his own cost cleaning of area allotted, construction of his temporary office, stores, cement godown etc. and also the watch and ward of all the above. Materials required for the same shall be provided by contractor at his own cost. | |
| 23.2 | BHEL contemplates to provide fabrication yard with in approx 1000 mtr from chimney. However, during execution, based on actual site conditions, requirement and layout and approaches, the above may change suitably. | |

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| **24.0** | **TOOLS & PLANTS (TO BE PROVIDED BY CONTRACTOR)** | |
| 24.1 | Tentative list of T&P to be deployed by contractor for successful completion of work is detailed below. | |
| 24.2 | It may be noted that the list is not exhaustive and is only for guidance. The contractor is required to provide all necessary T&P (other than those specified to be provided by BHEL, if any) measuring (calibrated) instruments & handing equipments to maintain work progress for timely completion of total work as per contract. In case of project requirement, some activities may have to pre-pone. In such cases the contractor have to deploy additional T&P. Quoted rate shall be inclusive of such emerging requirements. However, contractor shall submit deployment plan of all T&P after order to BHEL / SITE. | |
| 24.3 | In the event of any failure on the part of the contractor to deploy T & P to sustain desired work progress, BHEL may at his discretion also terminate the contract on this ground and take out any or whole amount of the contract from the scope of the contractor. In the event of failure of contractor to deploy necessary and sufficient T&P/ IMTEs to maintain work progress, **BHEL will arrange the same including mobilization, demobilization, hiring charge, fuel charge etc of same from any of BHEL site/ other agency & charges** as applicable plus 10% **at the risk & cost of contractor** shall be deducted from contractor's RA bill. BHEL also reserve for suitable deduction towards non-depolyment of T&P as per project requirement in line with BHEL's rate of T&P charges available at BHEL/site through corporate circular time to time. Decision of BHEL in this regard will be final & binding on contractor. | |
| 24.4 | Following Major T&Ps to be arranged by contractor within the time as indicated : | |
| | **Major T&P items** | **Mobilizing time from start date** |
| 24.4.1 | 2 Nos. Hydraulic Excavator/Poclain | Within 30 days |
| 24.4.2 | 2 Nos. Dozer | Within 20 days |
| 24.4.3 | 10 Nos. Dumper | Within 30 days |
| 24.4.4 | 2 Nos. Vibromax/Earth Compactor | As per site requirement |
| 24.4.5 | 2 Nos. Air Compressor | As per site requirement |
| 24.4.6 | 2 Nos. 18 / 20 T Crawler Crane | Within 210 days. |
| 24.4.7 | 2 Nos Hydra (10 / 12 T Cap) | within 90 days. |
| 24.4.9 | 30 Nos Welding Machine | As per requirement |
| 24.4.10 | Motorized MS plate bending machine along with angle bending device – 1 no. | Within 120 days |
| 24.4.11 | 6 Nos Transit Mixer (5 / 6 Cum capacity) | 3 Nos Within 30 days<br>Balance 3 Nos within 60 days |
| 24.4.12 | 4 No Concrete Pump (20 cum/ hr min capacity & lift 70M) | Within 75 days. |
| 24.4.13 | 5 Nos Self Priming Dewatering Pump 5 HP (diesel / electric) | Within 20 days. |
| 24.4.14 | 5 Nos Multi stage high lift water Pump (for curing) (lifting height shall be 175 metre). Two shall be working and other will be stand by. | Within 75 days. |
| 24.4.15 | 2 Nos Pneumatic Hammer. | As per site requirement |
| 24.4.16 | 6 Nos Reinforcement Bending Machine | Within 30 days |
| 24.4.17 | 4 Nos Reinforcement Cutting Machine | Within 30 days |
| 24.4.18 | 1 No Compression Testing Machine (200 T Cap) | As per site requirement |
| 24.4.19 | Civil laboratory equipments as per list attached in ANNEX `A & A1' | Within 60 days. |
| 24.4.20 | Power Winch – 3 T - 4 nos for structural erection. | As per requirement |
| 24.4.21 | Power Winch – 5 T – 2 nos for structural erection. | As per requirement |
| 24.4.22 | Power Winch – 10 T - 4 nos for structural erection | As per requirement |
| 24.4.23 | 1 No Total Station | Within 20 days. |
| 24.4.24 | 2 Nos Auto Level & Staff | Within 20 days. |
| 24.4.25 | 2 nos DG set (suitable capacity as per requirement) | 1st Within 30 days.<br>2nd Within 75 days. |
| 24.4.26 | Concrete Cube Moulds – Adequate no. | As per requirement |

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| 24.4.27 | Slip / Inter form equipment set including required winches for man & material lifting, hydraulic spare pump, minimum 10% spare jack, epoxy painted MS shutter plate, wooden planks, materials and passenger hoist with safety block (safety devices), safety ropes etc complete - 2 sets minimum. | 1st to be mobilized within 90 days<br>2nd to be mobilized within 150 days<br>Balance - As per site requirement and discussion with BHEL(if reqd) |
| 24.4.28 | Strand Jack / winches with safety device lifting capacity 15 T | As per requirement |
| 24.4.29.a | Hanging platforms with safety device (two nos.) | As per requirement |
| 24.4.29.b | 2 Nos Trailor – 20T, | Within 30 days. |
| 24.4.29.c | 2 Nos Drinking Water Tank – 1000 Lit. | Within 30 days. |
| 24.4.30 | 2 Nos Ultra-Sonography Testing Machine for structural work. | As per requirement |
| 24.4.31 | 2 Nos Radiography Source. | Whenever required |
| 24.4.32 | Radioset – 1 no (VHF/UHF.) | Within 120 days. |
| 24.4.33 | 30 Cum/Hr. capacity of Automatic Batching Plant with Printing facility with required Silo for storing of Cement to be commissioned at Site. | Within 45 days |
| 24.4.34 | 15 Cum/Hr. capacity of Automatic Batching Plant with Printing facility with required Silo for storing of Cement to be commissioned at Site. | Within 60 Days |
| 24.4.35 | Ready mix concrete Testing Lab 1 AC Lab 4.50 m x 4.50 m and 1 Non-AC Lab 4.50 m x 6.00 m with required Equipment & Instrument as per Annexure – `A & A1' (Tentative List) | Within 60 Days |
| 24.4.36 | Portable fire extinguishers as below:<br>Soda acid – 4 sets.<br>Dry chemical powder – 4 sets<br>CO2 – 2 sets.<br>Water & sand bucket<br>(4 buckets in one stand) – 3 sets.<br>Fire hose with nozzle (50 M length) – 2 sets. | Within 60 days. |
| 24.5 | T&P shown in the above mentioned list are tentative and minimum requirement based on planned progress requirement.<br>Actual Mobilisation schedule, based on front availability, drawings and material availability at site is to be reviewed and mutually agreed with BHEL site periodically from time to time & form a joint MOM for moblisiation of major T&Ps, and the same have to be adhered to and no change will be permitted without written approval of BHEL site.<br>Further requirement will be reviewed time to time at site and contractor will provide additional T&P/ equipments to ensure completion of entire work within schedule time without any financial implication to BHEL. All other T&Ps shall be provided by the contractor without any extra cost to BHEL. Vendor will give advance intimation & certification regarding capacity etc prior to dispatch of heavy equipments. | |
| 24.6 | All T&P and all IMTEs, which are required for successful and timely execution of the work covered within the scope of this tender, shall be arranged and provided by the contractor at his own cost in working condition. | |
| 24.7 | In the event of non mobilsation of any T&P by the successful bidder and as a result progress of work sufferred, BHEL reserves the right to deduct suitable amount from the dues of the bidder, with assigning reasons thereof as per the following rate given below. | |
| | **T & P** | **Recovery** |
| 24.7.1 | Hydraulic Excavator/Poclain | Rs 50000/- per week or part thereof |
| 24.7.2 | Dozer | Rs40000 /- per week or part thereof |
| 24.7.3 | Dumper | Rs 5000/- per week or part thereof |
| 24.7.4 | Vibromax/earth compactor | Rs 40000/- per week or part thereof |
| 24.7.5 | Air Compressor | Rs 2000/- per week or part thereof |

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| 24.7.6 | 18/20 T crawler crane | Rs 20000/- per week or part thereof |
| 24.7.7 | Hydra (10/ 12 T cap) | Rs 15000/- per week or part thereof |
| 24.7.9 | Welding Rectifier | Rs 1000/- per week or part thereof |
| 24.7.10 | Motorized MS plate bending machine along with angle bending device | Rs 5000/- per week or part thereof |
| 24.7.11 | Transit mixer (5 / 6 M3 capacity) | Rs 7000/- per week or part thereof |
| 24.7.12 | Concrete Pump (20 cum/ hr min capacity & lift 70M) | Rs 20000/- per week or part thereof |
| 24.7.13 | Self Priming Dewatering Pump 5 HP (diesel/ electric) | Rs 2000/- per week or part thereof |
| 24.7.14 | Multi stage high lift water Pump (for curing) (lifting height shall be 175 metre). One shall be working and other will be stand by. | Rs 2000/- per week or part thereof |
| 24.7.15 | Pneumatic Hammer. | Rs 500/- per week or part thereof |
| 24.7.16 | Reinforcement Bending Machine | Rs 5000/- per week or part thereof |
| 24.7.17 | Reinforcement Cutting Machine | Rs 5000/- per week or part thereof |
| 24.7.18 | Compression Testing Machine (200 T Cap) | Rs 4000/- per week or part thereof |
| 24.7.19 | Civil laboratory equipments as per list attached in ANNEX `A` | Rs 500/- per week or part thereof |
| 24.7.20 | Power Winch – 3 T | Rs 2000/- per week or part thereof |
| 24.7.21 | Power Winch – 5 T | Rs 3000/- per week or part thereof |
| 24.7.22 | Power Winch – 10 T | Rs 5000/- per week or part thereof |
| 24.7.23 | Total Station | Rs 5000/- per week or part thereof |
| 24.7.24 | Auto Level & Staff | Rs 5000/- per week or part thereof |
| 24.7.25 | 2 nos DG set (suitable capacity as per requirement) | Rs 20000/- per week or part thereof |
| 24.7.26 | Slip / Inter form equipment set including required winches for man & material lifting, hydraulic spare pump, 10% spare jack, epoxy painted MS shutter plate, materials and passenger hoist with safety block (safety devices), safety ropes etc complete. | Rs 200000/- per week or part thereof per set. |
| 24.7.27 | Strand Jack / winches with safety device lifting capacity 15 T | Rs 10000/- per week or part thereof |
| 24.7.28 | Hanging platforms with safety device | Rs 15000/- per week or part thereof |
| 24.7.29.a | Trailor – 20T, | Rs 10000/- per week or part thereof |
| 24.7.29.b | Drinking Water Tank – 3000 Lit. | Rs 5000/- per week or part thereof |
| 24.7.29.c | Ultra-Sonography Testing Machine For Structural Work. | Rs 5000/- per week or part thereof |
| 24.7.30 | Radiography Source. | Rs 500/- per week or part thereof |
| 24.7.31 | Radioset – 1 no (VHF/UHF.) | Rs 500/- per week or part thereof |
| 24.7.32 | Any other equipment/T &P | As per discretion of engineer |
| 24.8 | After completion of major quantum of work, vendor may be permitted to take out any of his T&P progressively, if deemed fit by BHEL Site as per balance work program. The same will be jointly agreed and recorded. BHEL decision in this regard will be final and binding on the vendor. | |
| 24.9 | It is not obligatory on the part of BHEL to provide any tools and tackles or other materials other than those specifically agreed to do so by BHEL. However, depending upon the availability, BHEL / BHEL's Customer handling equipment and other plants may be made available to the contractor on payment of higher charges as fixed, subject to the conditions laid down by BHEL/Customer from time to time. Unless paid in advance, such hire charges, if applicable shall be recovered from contractor's bill / security deposit or any other payment in one installment. | |
| **25.0** | **CIVIL LABORATORY** | |

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| | Contractor shall establish and maintain civil laboratory Room with necessary equipment for conducting relevant site tests, as required. Tentative list of Lab equipments to be deployed / arranged by the contractor are given in Annexure-A. | | |
| **26.0** | **CONSTRUCTION SCHEDULE** | | |
| 26.1 | **INITIAL MOBILIZATION:**<br>After receipt of LOI, Contractor shall discuss with Project Manager / Construction Manager regarding initial mobilization. Contractor shall mobilize necessary resources within 15 days of issue of letter of intent or as per the directive of Project Manager / Construction Manager.Such resources shall be progressively augmented to match the schedule of milestones as directed by BHEL Engineer | | |
| 26.2 | Entire work shall be carried out in accordance with the broad construction / Milestone schedule, within the stipulated completion period. Within 30 days of LOI, the contractor shall discuss with BHEL site engineer & furnish detail construction schedule (L-3/ L-4) indicating all milestones on the basis of major activities and get it approved from BHEL engineer. This schedule will undergo review and based on progress vis-à-vis project requirement, contractor shall have to submit revised schedule for approval of BHEL. | | |
| 26.3 | **START DATE / ZERO DATE**<br>The schedule date of start of work shall be the date after 15 days of issue of LOI; The Actual Date of Start of Contract Period (Zero Date) shall be date of handing over of site to contractor for work and shall be certified by the BHEL Engineer. | | |
| 26.4 | **Sl. No.** | **Activity** | **Completion time** |
| | **A** | **SERVICE PART** | |
| | 1 | Completion of Raft foundations of Chimney for 1st Unit | 3 months |
| | 2 | Completion of RCC Wind Shield for 1st Unit | 7 months |
| | 3 | Completion of Steel Flue for 1st Unit | 9 months |
| | 4 | Completion of Borosilicate Lining work for 1st Unit | 11 months |
| | 5 | Completion of all work for 1st Unit | 12 months |
| | **B** | **SUPPLY PART** | |
| | 1 | Design & drawing Approval | 4 months |
| | 2 | Manufactuing Quality Plan Approval | 5 months |
| | 3 | Supply of Elevator for 1st Unit | 7 months |
| | 4 | Supply of Electrical Items for 1st Unit | 9 months |
| | **C. Phase gap between each unit shall be 3 Months. Hence total Completion time for all four units is 21 Months.** | | |
| 26.5 | Contractor shall submit structural fabricaton drawings within 15 days from the release of engineering drawings by BHEL.<br>Vendor to ensure checking of detail drawing and obtaining approval from PEM through the approved agency within 15 days from detail drawing fabrication submission date. Vendor has to ensure availability of approved drawing at site immediately after the approval.<br>List of the agency for structural drawing detailing and checking are attached in Annexure-B. This list is indicative and for tender purpose only. Vendor has to ensure approval of such agency from BHEL-PEM within 45 days from the date of LOI. | | |
| 26.6 | Contractor shall submit daily work program based on above construction schedule. Defferement of above schedule is not acceptable. Contractor will adhere to schedule and resource planning to be augmented to ensure completion as per schedule. | | |
| 26.7 | Above schedule is indicative. The contractor shall plan his work in such a manner so as to meet the overall project schedule, in consultation with BHEL/NTPC Engineer. In order to meet above schedule in general, and any other intermediate targets set, to meet customer/ project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL without any extra cost to BHEL. | | |
| 26.8 | In case due to reasons not attributable to the contractor, the work gets delayed and scheduled completion gets extended, time extension will be granted by BHEL as per clause no. 2.11 of GCC. | | |

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| 26.9 | It may be noted that in the event, delay in completion is attributable to the contractor; BHEL will impose LD on the contractor as per clause no. 33.0 of TCC. |
| **27.0** | **COMPLETION PERIOD** |
| | The entire work under this scope shall be successfully completed within 21 (twenty one) months from the date of Start of work.<br><br>Mobilisation period is 15 days from the date of LOI / intimation by Construction Manager BHEL, Nabinagar Site whichever is later. |
| **28.0** | **CERTIFICATE TOWARDS COMPLETION** |
| | The work under the scope of the contractor shall be deemed to have been completed in all respects only when so certified by CM, BHEL / NTPC. The decision of BHEL in this regard shall be final and binding on the contractor. |
| **29.0** | **EXTENSION OF TIME FOR COMPLETION** |
| 29.1 | If the completion of work as detailed in the scope of work gets delayed beyond the contract / completion period, the contractor shall request for an extension of the contract and BHEL at its discretion may extend the contract. |
| 29.2 | Based on the reviews jointly signed, the works balance at the end of original contract period less the backlog attributable to the contractor shall be quantified, and the number of months of 'Time extension' required for completion of the same shall be jointly worked out. Within this period of 'Time extension', the contractor is bound to complete the portion of backlog attributable to the contractor. Any further 'Time extension' or 'Time extensions' at the end of the previous extension shall be worked out similarly. |
| 29.3 | However, if any 'Time extension' is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/ LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take at the risk and cost of contractor. |
| 29.4 | A joint programme shall be drawn for the balance amount of work to be completed during the period of 'Time Extension', along with matching resources to be deployed by the contractor as per specified format. Review of the programme and record of shortfall shall be done. |
| 29.5 | During the period of 'Time extension', contractor shall maintain their resources as per mutually agreed program. |
| 29.6 | At the end of total work completion as certified by BHEL engineer, and upon analysis of the total delay, the portion of time extensions attributable to (i) Contractor, (ii) Force majeure conditions, and (iii) BHEL, shall be worked out and shall be considered to be exhausted in the same order. The total period of time extensions shall be the sum of (i), (ii) and (iii) above and shall be equal to period between the scheduled date of completion and the actual date of completion of contract. LD shall be imposed/ levied for the portion of time extensions attributable to contractor and recoverable from the dues payable to the contractor. |
| **30.0** | **MOBILIZATION ADVANCE/ INTEREST BEARING RECOVERABLE ADVANCE** |
| | Not applicable. |
| **31.0** | **SECURITY DEPOSIT & PERFORMANCE BOND** |
| 31.1 | Security deposit shall be applicable as per relevant clause of GCC (Volume-IB). |
| 31.2 | Performance bond is applicable for Part-1B (SCH-3-SERVICE PART) and SCH-4-SUPPLY PART of price schedule, value as per following terms. |
| 31.2.1 | In addition to the security deposit, the contractor shall provide to BHEL bank guarantee from an approved nationalized bank for an amount equal to 5% of the stated price as performance bond (under the terms of a bond) within 30 days from the date of LOI and the terms of the said bond shall be such as shall be approved by BHEL. The bond shall remain valid until 6 months after the expiry of warranty/ guarantee period. The obtaining of such guarantee and the cost of bond to be so entered into shall be at the expense in all respects to the contractor. |
| 31.2.2 | BHEL reserve the right of forfeiture of the above bond in addition to other claims and penalties in the event of the contractor's failure to fulfil any of the contractual obligations or in the event of termination of contract as per terms and conditions of |

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| | contract. BHEL reserve the right to set off this bond against any claim of any other contract with BHEL. |
| **32.0** | **REVISION ON ACCEPTED CONTRACT RATE** |
| | Not applicable in this tender. |
| **33.0** | **LIQUIDATED DAMAGE/ PENALTY** |
| **33.1** | **Intermediate Milestones (Applicable for each unit separately)** |
| 33.1.1 | In case delay in achieving the Milestone as mentioned in Clause 26.4.A.2 above in each unit , is solely attributable to the contractor, 0.25% per week of executable Contract Value, limited to maximum 1% of executable Contract Value, will be withheld. |
| 33.1.2 | In case delay in achieving the Milestone as mentioned in Clause 26.4.A.4 above in each unit , is solely attributable to the contractor, 0.25% per week of executable Contract Value, limited to maximum 1.25% of executable Contract Value, will be withheld. |
| 33.1.3 | Amount already withheld, if any against slippage of clause 26.4.A.2 & 26.4.A.4 above in each unit, shall be released only if there is no delay attributable to contractor in achievement of Milestone as mentioned in clause 26.4.A.5 of respective unit. |
| 33.1.4 | Amount to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills. |
| 33.1.5 | In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted into recovery. |
| 33.2 | Final Completion(Applicable for each unit separately) |
| 33.2.1 | Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract of each unit separately. Withheld amount, if any due to slippage of identified intermediate milestone(s) of respective unit shall be adjusted against LD or released as the case may be. |
| 33.2.2 | If the completion of work of the unit is delayed beyond the completion period (Refer clause 26.4.A.5 & 26.4.C above) due to reasons attributable to the contractor, they shall pay to BHEL as penalty a sum @ 0.5% of Contract Value per week of delay or part thereof. For Unit # 1, overall LD including LD against intermediate milestones shall be limited to maximum 2.5% of contract value. For Unit # 2, overall LD including LD against intermediate milestones shall be limited to maximum 2.5% of contract value. For Unit # 3, overall LD including LD against intermediate milestones shall be limited to maximum 2.5% of contract value and for Unit # 4, overall LD including LD against intermediate milestones shall be limited to maximum 2.5% of contract value Thus maximum LD considering four units shall be limited to 10% of contract value. |
| 33.2.3 | All other terms shall be as per the provision of GCC in this regard. |
| 33.3 | In case of LD recovery, the applicable GST shall also be recovered from the contractor. |
| **NOTE:-** | Executable Contract Value – Value of work for which inputs/ fronts were made available to contractor and were scheduled for execution till the date of achievement of the Milestone. |
| **34.0** | **CONTRACT PRICE** |
| 34.1 | The bidder shall quote their rates strictly in accordance with prescribed Price schedule of Volume-III (Latest revision). |
| 34.2 | The quantities of the various items mentioned in the respective Price schedules, Volume-III are approximate, based on very preliminary information and may vary to any extent or to be deleted altogether. The quoted rates of each item will remain firm throughout the period of execution including extension, for reasons whatsoever, as long as variation in the total value of the work executed under any part of this contract including extra items, if any, but excluding any price variation, remains within +/- 15 % (plus/minus fifteen percent) of the awarded price (as per LOI / WO). |
| 34.3 | The unit rate quoted for various items of BOQ shall include all the stipulation mentioned in the tender documents and nothing extra over BOQ rates shall be payable. |
| 34.4 | However, the contractor shall inform BHEL in case quantity variation of any item |

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| | crosses + 50% (plus fifty percent) limit during execution and obtain approval/consent of CM, BHEL for execution of further quantity for this item. |
| 34.5 | Total price (Supply & service parts together) will be considered for evaluation. |
| 34.6 | Price schedule is split into 2 parts, service part & supply part, total of which shall be taken into account for evaluation and awarding. Contractor shall supply all material covered under supply part of price schedule. Unless otherwise specified in price schedule, contractor shall obtain prior approval from BHEL / owner regarding manufacturer / make of all items under contractor's scope of supply (under service part or supply part of price schedule). |
| **35.0** | **TAXES AND DUTIES** |
| 35.1 | All taxes excluding GST & BOCW Cess (as specified elsewhere in the tender) but including, Charges, Royalties, any State or Central Levy and other taxes for materials if any obtained for the work and for execution of the contract shall be borne by successful bidder and shall not be payable extra by BHEL. Any increase of above at any stage during execution of contract, including extension of the contract, shall have to be borne by successful bidder contractor. Bidder's quoted/ accepted rates/ price shall be inclusive of all such requirements. |
| 35.2 | GST along with Cess (as applicable) legally leviable & payable by successful bidder as per GST Law shall be paid by BHEL, extra. Hence, bidder shall not include GST along with Cess (as applicable) in their quoted rates/ price. |
| 35.3 | Successful bidder shall furnish proof of GST registration with GSTN Portal covering the services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by successful bidder on BHEL for this project / work. |
| 35.4 | Since GST on output will be paid by BHEL separately as enumerated above, bidder's your quoted rates / price should be after considering the Input Credit under GST law at bidder's end. |
| 35.5 | TDS under Income Tax shall be deducted at prevailing rates on gross invoice value from the running bills (RA bills) unless exemption certificate from the appropriate authority / authorities is furnished. |
| 35.6 | TDS under GST shall be deducted at applicable rates on gross invoice value from the running bills (RA bills). |
| 35.7 | Bidder shall note that GST Tax Invoice complying with GST Invoice Rules (Section 31 of GST Act & Rules referred thereunder) wherein the 'Bill To' details shall encompass following. BHEL GSTN – Refer attached GSTN code table of BHEL. Name - BHARAT HEAVY ELECTRICALS LIMITED Address - Shall be intimated later. Specific details of BHEL GSTN, Name and Address as stated above, have been specified elsewhere in the tender. |
| 35.8 | Successful bidder to intimate immediately on the day of removal of goods (in case of any supply of goods) to BHEL along with all relevant details and send a scanned copy of Tax Invoice to BHEL through following communication mode for enabling BHEL to meet its GST related compliances. Portal address. and Email address – Shall be intimated later. Specific details of above shall be intimated to successful bidder by BHEL at appropriate juncture. |
| 35.9 | In case of delay in submission of above-mentioned documents on the date of despatch, BHEL may incur penalty / interest for not adhering to Invoicing Rules under GST Law. The same will be liable to be recovered from successful bidder, in case such delay is not attributable to BHEL. |
| 35.10 | In case of raising any Supplementary Tax Invoice (Debit / Credit Note), successful bidder shall issue the same containing all the details as referred to in Section 34 read with Section 31 of GST Act & Rules referred there under. |
| 35.11 | Successful bidder shall comply with the Time Limit prescribed under the GST Law and rules thereof for raising of the Tax Invoice. If any supply of goods is applicable, successful bidder shall also ensure prompt delivery of goods after despatch. |
| 35.12 | Bidder shall note that in case GST credit is delayed / denied to BHEL due to delayed / non receipt of goods and / or Tax Invoice or expiry of the timeline prescribed in GST Law for availing such ITC, or any other reasons, not attributable to BHEL, GST amount shall be recoverable from successful bidder along with interest levied/ leviable |

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| | on BHEL, as the case may be. |
| 35.13 | Successful bidder shall upload the invoices raised on BHEL in GSTR-1 within the prescribed time as given in the GST Act. Bidder shall note that in case of delay in declaring such invoice in your return and GST credit availed by BHEL is denied or reversed subsequently as per GST Law, GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from the successful bidder along with interest levied / leviable on BHEL. |
| 35.14 | Way Bill: Successful bidder to arrange for way bill / e-waybill for any transfer of goods for the execution of the contract. Successful bidder has to make their own arrangement at their cost for completing the formalities, if required, with Issuing Authorities, for bringing materials, plants & machinery at site for execution of the works under this contract, Road Permit / Way Bill, if required, shall be arranged by successful bidder and BHEL will not supply any Road Permit/ Way Bill for this purpose. |
| 35.15 | Any new taxes & duties, if imposed subsequent to due date of offer submission as per NIT & TCN, by statutory authority during contract period (including extension, if the same is not attributable to you), shall be reimbursed by BHEL on production of relevant supporting document to the satisfaction of BHEL. However, you shall obtain prior approval from BHEL before depositing new taxes and duties. |
| 35.16 | Benefits and / or abolition of all existing taxes must be passed on to BHEL against new taxes, if any, proposed to be introduced at a later date. |
| **36.0** | **INTERIM PAYMENTS** |
| **36.1** | **SERVICE PART (SCH-3 OF PRICE SCHEDULE, VOL-III)** |
| 36.1.1 | For all items of works, as per the Price schedule, Vol-III, billing shall be on item rate basis. However, Interim Payment shall be limited to 95% of gross bill amount. |
| 36.1.2 | All admissible recovered/ adjustments etc. shall be made from the interim payable amount. |
| 36.1.3 | Balance 5 % retained from each RA bill will be released on completion of guarantee period. However, this 5 % payment can be released against submission of bank guarantee valid for the guarantee period as stated above in Proforma / Format of performance bank guarantee, subject to receipt of certificate that all works are completed in all respects. Submission of bank guarantee towards retention is separate and other bank guarantee(s) cannot be utilized for this purpose. This retention bank guarantee will be refunded after guarantee period. |
| 36.1.4 | 1.5 % of gross bill amount shall be paid in the following manner on certification by BHEL engineer after compliance of each of following activity in each month. In case of non-fulfilment of respective activity by vendor in each month, no payment shall be made by BHEL against corresponding activity and no claim of bidder at a later date, whatsoever, in this regard shall be entertained by BHEL. |
| 36.1.4.1 | 0.7 % shall be paid on compliance of housekeeping of vendor's working area and store/ office areas. |
| 36.1.4.2 | 0.3 % shall be paid on compliance of general illumination of vendor's working area and stores, office area. |
| 36.1.4.3 | 0.2 % shall be paid on compliance of applicable OHSAS requirement as per guidelines of BHEL/ PSER and as specified in the tender. |
| 36.1.4.4 | 0.3 % shall be paid on compliance of applicable safety requirement as per guidelines of BHEL/ PSER and as specified in the tender. |
| 36.1.5 | Contractor's RA bill, complete & correct in all respects, certified by BHEL engineer, shall be paid after 45 days of receipt of bill with all supporting documents. |
| 36.1.6 | BHEL site at its discretion, may further split up the above percentages of break up and effect payment to suit the site condition, cash flow requirement, according to the progress of work. |
| 36.1.7 | Such payment as above shall be affected only on certification by BHEL against completion of each stage. |
| 36.1.8 | Applicable GST, which can be claimed at any point, shall be released to you upon compliance of following: |
| 36.1.8.1 | You declaring such Invoice in his GSTR-1 |
| 36.1.8.2 | Receipt of Goods / services and Tax Invoice by BHEL |

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| 36.1.8.3 | Confirmation of payment of GST thereon by you on GSTN Portal |
| **36.2** | **SUPPLY PART (SCH-4 OF PRICE SCHEDULE, VOL-III)** |
| 36.2.1 | Payment shall be made by BHEL site office after 45 days of receipt of invoice subject to its completeness in all respects as per BHEL's procedure. All admissible recovered / adjustments etc shall be made from the interim payable amount. BHEL may release payment through electronic mode, for which bidder shall comply with necessary requirement. |
| 36.2.2 | For all items of work as per rate schedule of main supply, payment shall be made as per following break-up of contract price. |
| 36.2.2.1 | 5 % of basic price of materials on submission and approval of all basic design documents such as data sheets/ drawings, quality plans etc as per tender. |
| 36.2.2.2 | 65 % of basic price of materials supplied along with 100 % GST (as applicable) against dispatch document on pro-rata dispatch of material to site as per approved billing schedule. Documents (required sets) required, as applicable, for such payment are as follows. |
| 36.2.2.2.1 | GST invoice in original. |
| 36.2.2.2.2 | LR / RR (consignee copy). |
| 36.2.2.2.3 | Packing list. |
| 36.2.2.2.4 | BHEL / customer MDCC enclosing QS note, inspection & test certificate, wherever applicable. |
| 36.2.2.2.5 | Copy of letter, addressed to insurance company intimating dispatch. |
| 36.2.2.3 | 10 % of basic price of materials received along with 100% freight & others, against Material Receipt Certificate (MRC) issued after receipt of materials and its physical verification at site on pro-rata basis. Collection of MRC from the site and its submission for claiming the payment shall be bidder's responsibility. |
| 36.2.2.4 | 10 % of the basic price shall be released against completion of erection of the equipments supplied. |
| 36.2.2.5 | 10 % of basic price shall be released against (i) Trial run of the system / package ii) Successful completion of PG (Performance guarantee) test / demonstration test of the system / package, as applicable, (iii) Submission of final documents, e.g. as-built drawings, O&M manual etc and (iv) Handing over of the system / package to the NTPC.<br>In case of delay in completion of PG Test / demonstration test for the reasons not attributable to the vendor, this amount can be paid on submission of BG of equivalent amount, valid initially for 6 months & to be revalidated till completion of trial run or PG test / demonstration test or handing over of the system / package, whichever is later.<br>However, vendor has to complete all other activities and fulfill all formalities for final billing / contract closing prior to drawing this payment. |
| 36.2.3 | Detail billing schedule shall be submitted by the successful vendor to BHEL for approval within 60-days of LOI or otherwise specified by BHEL after placement of LOI. |
| 36.2.4 | BHEL site, at discretion, may further split up the above percentages and effect payment to suit the site condition, cash flow requirement, according to the progress of work. |
| **37.0** | **PRICE VARIATION CLAUSE(PVC)** |
| | Not applicable for this tender. |
| **38.0** | **OVER RUN CHARGES(ORC)** |
| | Not applicable for this tender. |
| **39.0** | **METHOD OF MEASUREMENT** |
| | Mode of measurement shall be as per relevant clauses of technical specification of this tender. In case the same is not available the relevant IS 1200 in conjunction of IS code 3385 shall be adopted. In case the same is also not available, the standard procedure adopted in CPWD shall be adopted. In case the same is also not available in CPWD, the measurement of the work done will be based on the mutual agreement between BHEL and contractor. In all the above cases, the interpretation of BHEL will be final and binding to the contractor. |
| **40.0** | **EXTRA/ ADDITIONAL ITEMS OF WORK** |

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| | It shall be as per relevant clause no. 2.15 of GCC.However DSR-2018 to be referred for cl. no. 2.15.7-b. |
| **41.0** | **DESIGN OFFICE AND FABRICATION DRAWING** |
| 41.1 | Based on design drawings of structures, to be issued to the contractor from time to time by BHEL, contractor will prepare & submit within 15 days of receipt, the detail fabrication / shop drawing including tabulated form of bill of materials (BOM), joint calculations, for comments / approval of BHEL at the office of BHEL / PEM, Noida. BHEL reserves the right to assess the capability of the agency to be deployed by contractor for preparation of such fabrication drawing, and prior approval from BHEL Engineering office at Noida, is required for appointment of such agency. |
| 41.2 | Since time is the essence of the contract, the contractor must indicate the location of their design office where from such detailed activities will be made operative. It is preferred that the contractor have establishment / liason office at Delhi / Noida with a co-ordinator for better co-ordination with BHEL-PEM. |
| 41.3 | Contractor shall submit progress report pertaining to fabrication drawing, by 7$^{th}$ of each month, drawing-wise, section-wise cumulative bill of materials for which engineering drawing has been issued to them and status of fabrication drawing. |
| 41.4 | Based on specification vendor has to design the electrical drawing & aviation lights for chimney within the time schedule mentioned in relevant clause. Based on approval from BHEL / NTPC, vendor has to procure & supply the materials at site. |
| 41.5 | As per specification, vendor has to submit the design, MQP & drawing for elevator. On approval of the same, vendor has to take further action for supplying the Elevator to site. |
| **42.0** | **FABRICATION** |
| 42.1 | All the fabrication of structural steel items (**except work done at qualified shop(s) out side the project premises as per BOQ cum Price schedule**) shall be done in fabrication yard inside project premises. Quality plan for structural works will be issued during execution stage upon approval of customer<br>Bidders to note that all fasteners like MS / HT / HSFG bolts, nuts, lock nuts, washers etc shall be supplied by bidder as per technical specification / drawings. |
| 42.2 | Bidder, at his own cost, shall supply electrodes required for fabrication, erection of structural steel as per specification and approval of BHEL. |
| | Above mentioned clauses pertaining to consumption and wastage of structural steel applies to those materials issued by BHEL for site fabrication. |
| **43.0** | **INSURANCE** |
| 43.1 | BHEL shall arrange comprehensive MCE (marine cum erection) Insurance Policy for total project supply & services including balance of plant package covering transit risks & loss, destruction or damage during handling at Site, Storage, civil works ,erection, testing and commissioning up to trial operation completion of unit including theft, sabotage, fire, lightning and other natural calamities. |
| 43.2 | Contractor shall report to BHEL in writing any damages to equipment/components on receipt, storing, and during withdrawal of the materials from stores, in transit to site and unloading at place of work and during erection and commissioning till trial operation completion including handing over. The above report shall be as prescribed by BHEL site management. Any consequential loss arising out of non-compliance of this stipulation will be borne by contractor. |
| 43.3 | The contractor will take necessary precautions/ due care to protect the material at Project site, while in his custody from any damage/ loss till the same is handed over to BHEL / customer at Project site. For lodging/ processing of insurance claim the contractor will submit necessary documents. BHEL will reserve the right to recover the loss from the contractor as detailed below in case the damage/loss is due to negligence/ carelessness on the part of the contractor. In case of theft of material under contractor's custody, the same shall be reported to police by the contractor immediately and copy of FIR and subsequently police investigation report shall be submitted to BHEL / customer for taking up with insurance. However, this will not relieve the contractor of his contractual obligation for the materials in his custody. |
| 43.4 | In case the damage/loss/theft of materials are attributable to negligence/failure in discharging the duties and obligations of the contractor, the expenses incurred for |

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| | repair/replacement of such components in excess of the amount realized from the underwriters, limited to Normal Excess (Deductible Franchise) shall be recovered from the contractor. |
| 43.5 | Other conditions of Insurance shall be as per relevant clause of GCC/SCC. |
| **44.0** | **GUARANTEE** |
| 44.1 | The works shall be completed to the entire satisfaction of the Engineer and in accordance with the completion schedule as specified in the Contract, and all unused stores and materials, tools, plant, equipment, temporary buildings, site office, labor hutments and other things shall be removed and the site and work cleared of rubbish and all waste materials and delivered up clean and tidy to the satisfaction of then Engineer at the Contractor's expenses. |
| 44.2 | The Engineer shall certify to the contractor the date on which the work is completed and the date thereof for commencement of Guarantee Period. |
| 44.3 | Guarantee period shall be 12 months from the date of start of guarantee period as per relevant clause of GCC. |
| **45.0** | **OTHER TERMS** |
| 45.1 | While bidder's scope include deployment of all resources, like T&P, materials, consumables, manpower including supervision etc for proper completion of the subject job and no sub-contracting for execution of the job is allowed by BHEL, depending on project's requirement and on prior acceptance of BHEL, bidder may associate agencies for deployment of skilled / unskileld manpower only for site execution. Bidder should arrange all resources, like T&P, materials, consumables, supervision etc directly for the subject job. |
| 45.2 | Drawing showing enough details for the construction as per the specification shall be furnished to the contractor in a phased manner as far as possible. |
| 45.3 | The records / log-books / registers like Site Order Book, Hindrance Register, RMC / Steel Supply and Consumption Register, etc. are to be maintained properly by the vendor duly signed by BHEL representative. |
| 45.4 | All other term & conditions of this specification shall be governed by the pertinent provisions of SCC & GCC as applicable. |

## ANNEXURE- A
## LIST OF EQUIPMENTS FOR CIVIL SITE LABORATORY

| | CONCRETE TESTING EQUIPMENT | | | |
|---|---|---|---|---|
| **SL NO.** | **NAME OF TEST** | **NAME OF EQUIPMENT** | **SIZE OF EQIPMENT** | **IS REF.** |
| 1 | Concrete Compressive test | Digital Compressive Testing Machine with 2000 KN capacity. | 2000KN capacity | IS 2505 |
| 2 | Concrete Cube casting | Concrete Cube Mould | 150x150x150mm, minimum 50 sets desired considering Raft/Shell concereting activity. | IS 10086 |
| 3 | Workability of concrete | Slump cone | Standard, atleast 04 nos | IS 456 |

| | **Soil Testing Equipment (Levelling & Grading)** | | | |
|---|---|---|---|---|
| 1 | Liquid limit test | Liquid limit apparatus | Standard | IS 2720 |
| 2 | Core Cutter test | core cutter apparatus | Rammer, 4 nos of standard core cutter mould, dolly | IS 2720 |
| 3 | Proctor density test | Std proctor Compaction apparatus | Standard | IS 2720 |
| 4 | Moisture Content | Rapid moisture meter | Standard, atleast 04 nos | IS 2720 |

| | **Process Control Accessories** | | | |
|---|---|---|---|---|
| 1 | Hot air oven | Temperature range 50° C to 300° C | 600x600x600mm (min. size) | |
| 2 | Electronic balance | 1 no. | 1Kg x 0.001g | |
| 3 | Physical balance | 5 kg capacity | Weights upto 5 kg | |
| 4 | Thermometer | Temperature range 0° C to 150° C | Digital | |
| 5 | GI tray | 03 nos | 600x450x50mm, 450x300x40mm, 300x250x40mm | |
| 6 | Measuring jars | 2 nos set of each size | 100ml, 200ml, 500ml & 1000 ml | |
| 7 | Gauging trowlers | 2 nos | 100mm & 200 mm with wooden handle | |
| 8 | Spatula | 2 nos each size | 100mm & 200 mm with long blade wooden handle | |
| 9 | Stainless steel scoop | 2 nos each | 1 kg and 2 kg | |
| 10 | | | | |
| 11 | Digital pH meter | 01 nos | .01 mm least count | |
| 12 | Digital paint thickness meter for steel | 02 nos | 500-micron Range | |
| 13 | Digital paint thickness meter for masanory/concrete painting measurement | 02 nos | 150-micron range | |

## ANNEXURE- A1

## LIST OF EQUIPMENTS FOR CIVIL SITE LABORATORY

| SL NO. | NAME OF TEST | NAME OF EQUIPMENT | SIZE OF EQIPMENT | IS REF. |
|---|---|---|---|---|
| 1 | Initial & final setting time, Consistency of cement | Vicat Apparatus with desk pot | Standard | IS 5513 |
| 2 | Abrasion value test | Los Angles Abrasion testing machine | Standard | IS 2386 |
| 3 | Aggregate Impact value test | Aggregate Impact value testing machine. | Standard | IS 9377 |
| 4 | Aggregate crushing value test | Crushing value apparatus | Standard | IS 2386 |
| 5 | Flakiness index | Thickness gauge for measuring flakiness index. | Standard | IS 2386 |
| 6 | Elongation Index | Elongation gauge | Standard | IS 2386 |
| 7 | Bulk density, voids and bulking apparatus | Measuring cylinders | 3, 5,10 & 15 liters cylinders | |
| 8 | Ready mix concrete Compressive test | Digital Compressive Testing Machine. | 2000KN capacity | IS 2505 |
| 9 | Cement cube casting | Cube mould | 70.6 x 70.6 x 70.6 mm, 05 Nos. minimum | IS 10086 |
| 10 | Ready mix concrete Cube Testing | Ready mix concrete Cube Mould | 150x150x150mm, minimum 50 Nos. | IS 10086 |
| 11 | Workability of ready mix concrete | Slump cone | Standard, at least 04 nos | IS 456 |
| 12 | Specific gravity of aggregates | Pycnometer | Standard, at least 02 nos | IS 383 |
| 13 | Cement mortor vibration | Motorised vibration machine for cement cube casting | Standard | IS 4031 |
| 14 | Course aggregate Sieve analysis (Ready mix concrete & Road Works) | Sieve set | 450mm dia GI Frames Size: 125 mm, 90 mm, 75 mm, 63 mm, 53 mm, 40 mm, 20 mm, 16 mm, 12.5 mm, 10 mm, 4.75 mm, Pan and cover (2 Sets) | IS 383 |
| 15 | Fine aggregate sieve analysis | Sieve set | 200 mm dia Brass sieves; Size 4.75 mm, 2.36 mm, 1.18 mm 600 micron, 300 micron, 150 micron, 75 micron, 75 micron, Pan and cover (2 Sets) | IS 383 |
| 16 | Seive Shaker | Motorised Sieve shaker | Mfg. Catalogue | |
| 17 | Silt content check | Sand silt content beaker | Standard | |

| Process Control Accessories | | | | |
|---|---|---|---|---|
| Sl | Description of Equipment | Specification | Size / No. | |
| 1 | Hot air oven | Temperature range 50° C to 300° C | 600 x 600 x 600 mm (min. size) | |
| 2 | Electronic balance | 600g x 0.01g, 10Kg and 50 kg | 3 nos. | |
| 3 | Physical balance | 5 kg capacity | Loose weights up to 5 kg | |
| 4 | Thermometer | Temperature 0°C to 50°C | 1 No. Digital & 2 Analogue. | |
| 5 | | | | |
| 6 | Measuring jars | 100ml, 200ml, 500ml & 1000 ml | 2 nos. set of each size | |
| 7 | Gauging trowel | 100mm & 200 mm with wooden handle | 4 nos. | |
| 8 | Spatula | 100mm & 200 mm with long blade wooden handle | 2 nos. each size | |
| 9 | Stainless steel scoop | 2 kg and 5 kg | 2 nos. each | |
| 10 | | | | |
| 11 | Digital pH meter | 0.1 least count | 02 nos. | |
| 12 | | | | |
| 13 | | | | |
| 14 | GI tray | 600 x 450 x 50 mm, 450 x 300 x 40 mm, 300 x 250 x 40 mm | 02 nos. each | |
| 15 | Electric mortar mixer | 0.25 CUM capacity. | 01 no | |
| 16 | Rebound hammer test | Digital Rebound hammer | 01 nos. | IS 13311 |
| 17 | Ultrasonic pulse velocity test | UPV apparatus for ready mix concrete | 01 No. | |

**ANNEXURE- B**

**LIST OF STRUCTURAL DETAILER FOR CHIMNEY**

| Sl No. | Name of the Agency & Address | Previous Work |
|---|---|---|
| 1 | Prabhoo structure Consulting Engineers, Delhi<br>Ph – 011-26186829 | Telangana / Rourkela / Unchahar / North Karanpura 2 |
| 2 | A E Automation, Chennai<br>Ph - 9789859983 | Bhadradri, Chimney - 2 |
| 3 | Bharat Construction Co., Kolkata / Ranchi / New Delhi<br>Ph - 7857800001 | Ennore SEZ |
| 4 | ADS Engineering Consultant, Kolkata<br>Ph - 8826778359 | Bhadradri, Chimney – 1 / Bokaro / North Karanpura 1&3 |
| 5 | Ennar Structural Design consultant, Chennai | Korba / Marwa |
| 6 | Valtrack System Pvt Ltd., Chennai | North Chennai |
| 7 | Progressive Drafting Service, Delhi<br>Ph - 8045132348 | Barauni |
| 8 | Talent Associates, Delhi | Panipat |

Note: The above list is indicative and not exhaustive and is for tender purpose only.

The list of vendors mentioned hereunder may preferably be considered for the following items. However, in case the bidder proposes to procure items from other suppliers, specific approval may be required to be taken.

| Sl. No. | Item description | Probable vendors |
|---|---|---|
| 1 | CONSTRUCTION CHEMICALS – ADMIXURES, PLASTISIZERSS ETC. | SIKA INDIA LIMITED<br>CICO TECHNOLOGIES LIMITED<br>FOSROC CHEMICALS (I) PVT LTD,<br>BSF |
| 2 | PAINT AND PAINTING SYSTEM | BERGER<br>SHALIMAR PAINTS<br>JENSON AND NICHOLSON<br>KANSAI NEROLAC<br>AKZO NOBEL<br>ASIAN PAINTS |
| 3 | STRUCTURAL STEEL | STEEL AUTHORITY OF INDIA LTD<br>TATA IRON & STEEL CO LTD<br>INDIAN IRON & STEEL CO LTD<br>RASHITRYA \SPAT NIGAM LTD<br>JSPL LTD<br>ESSAR STEEL LTD<br>ISPAT INDUSTRIES LTD<br>JSW STEEL LTD<br>LLOYDS STEEL LTD<br>SUNFLAG STEEL & IRON CO., BHANDA.RA (MH) - Only rounds 15 to 115 mm, Flats 45 to120 mm, W - 4.75 to 28 mm Thk., Hex - Rods 15.5 to 42 mm & wire rods 5.5 to 38 mm |
| 4 | MINERAL WOOL FOR THERMAL INSULATION | ROCKWOOL INDIA LIMITED, HYDERABAD<br>ROCKWOOL INDUSTRIES, BHILAI<br>LAPINUS, MALANPUR (MP)<br>MINWOOLRAJANANDGAON<br>LLOYD INSULATION, BHILAI<br>U.P. TWIGA, BULENDSHAHAR |

| | | |
|---|---|---|
| 5 | CHIMNEY ELEVATOR | MEKASTER ENGG & EQPT (P) LTD. (GUJARAT)<br>ALIMAK, AB (SWEDEN)<br>UNIVERSAL CONSTRUCTION MACHINARY & EQUIPMENTS (PUNE) |

# 4X250 MW BRBCL NABINAGAR STPP
# FGD SYSTEM PACKAGE

## VOLUME II-B

## CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

## SECTION – C

### SPECIFIC TECHNICAL REQUIREMENTS

### (RCC CHIMNEY)

### SPECIFICATION NO. PE-TS-463-620-C002
### REV-00

Maharatna Company


**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**Power Sector, PPEI BUILDING, Plot No-25**
**SECTOR 16A, NOIDA-201301, UP**

| | | |
|---|---|---|
| Maharatna Company | **TITLE: - 4X250 MW BRBCL NABINAGAR FGD**<br>**SPECIFICATIONS FOR RCC CHIMNEY** | SPECIFICATION NO. PE-TS-463-620-C002<br>VOLUME : IIB<br>SECTION : C<br>REV.NO. 00<br>SHEET |

## PREAMBLE

Standard technical details as indicated in specification shall be agreed upon between BHEL & Bidder.

Technical requirements are stipulated in this Volume which comprises of

Section C : This section indicates the technical requirements specific to the contract not covered in Section D

Section D : This section comprises of technical specification(s)

The requirements mentioned in the Section C shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the Section D in the specification. In case on any conflict between technical specification and BOQ, BOQ shall prevail.

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Sub-section D2: Cement concrete (Plain and reinforced) and formwork

Sub-section D3: Carpentry and joinery

Sub-section D4: Roof and underground structures water proofing, insulation and allied works

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Sub-section D6: Glass and glazing.

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Sub-section D17: Fabrication of structural steelwork

Sub-section D18: Erection of structural steelwork

Sub-section D19: Roof decking

| | | |
|---|---|---|
| Maharatna Company | **TITLE: - 4X250 MW BRBCL NABINAGAR FGD**<br>**SPECIFICATIONS FOR RCC CHIMNEY** | SPECIFICATION NO. PE-TS-463-620-C002<br>VOLUME : IIB<br>SECTION : C<br>REV.NO. 00<br>SHEET |

Sub-section D20: False flooring

Sub-section D21: Bored cast in situ RCC pile

Sub-section D22: Levelling and grading

Sub-section D23: Anti termite

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Sub-section D25: RCC stack

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# SECTION-C

# SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL WORKS

# SPECIFICATION NO. PE-TS-463-620-C002

# LOT-IA PROJECTS

## SECTION - VI

## TECHNICAL SPECIFICATION
## FOR
## FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

**THE TECHNICAL SPECIFICATION, SECTION - VI COMPRISE OF THE FOLLOWING PARTS**

---

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| SUB-SECTION-II-A2 | PROJECT INFORMATION- LARA-I 2X800 MW |
| SUB-SECTION-II-A3 | PROJECT INFORMATION- GADARWARA-I 2X800 MW |
| SUB-SECTION-II-A4 | PROJECT INFORMATION- DARLIPALLI-I 2X800 MW |
| SUB-SECTION-II-A5 | PROJECT INFORMATION- MOUDA-II 2X660 MW |
| SUB-SECTION-II-A6 | PROJECT INFORMATION- SOLAPUR-II 2X660 MW |
| SUB-SECTION-II-A7 | PROJECT INFORMATION- TANDA-II 2X660 MW |
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| | |
|---|---|
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| | |
|---|---|
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## PART – B (DETAILED TECHNICAL SPECIFICATION)

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**(CIVIL WORKS)**

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(PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS)

**PART - C**

GENERAL CONDITIONS OF CONTRACT

**PART - D**

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**PART - E**

LIST OF TENDER DRAWINGS

**PART - F**

ATTACHMENT-12 TO SECTION-VII (TECHNICAL DATA SHEETS)

# SUB-SECTION-II-A11

# PROJECT INFORMATION- NABINAGAR 4X250 MW

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**1.00.00 BACKGROUND**

**Details of proposed Stage / Units**

| | | |
|---|---|---|
| Project name | : | Nabinagar TPP |
| No. of Units x capacity | : | 4 x 250 MW |
| Project setting up by | : | NTPC(FOR BHARTIYA RAIL BIJLEE COMPANY LTD.) |

The SG with ESP package and TG package of the subject project is being executed by M/s. BHEL.

**1.01.00 LOCATION AND APPROACH**

| | | |
|---|---|---|
| Project Location | : | (i) Place : Nabinagar |
| | : | (ii) District : Aurangabad |
| | : | (iii) State : Bihar |
| Latitude and Longitude of project location | : | North : 24 deg. 42' 30" (N)<br>East : 84 deg. 05' 36" (E) |
| Nearest Railway station | : | Dehri-On-Sone |
| Distance of project location from the Railway station | : | 30 KM (Approx.) |
| Nearest MajorTown | : | Aurangabad |
| Distance of the town from the Project site | : | 50 KM |
| Nearest CommercialAirport | : | Gaya |
| Distance of airport from the project site | : | 100 KM |
| Nearest Highway | : | National Highway-2 |
| Distance from nearest highway point to the site | : | 25 KM |
| Vicinity plan | : | Vicinity plan of the project enclosed at Annexure-I. |
| Any other information | : | Further to the information given in this sub-section, Bidders are advised to visit the project site and collect data on local site conditions. |

| CLAUSE NO. | PROJECT INFORMATION | |
|---|---|---|
| **1.02.00** | **LAND REQUIREMENT** | |
| | Total area of land acquired for the project | : 1700 Acres |
| | Any other information | : Approximately 1700 acres of land has been identified near Dhundhua village for the Plant, Township and Ash Disposal Area. In principle commitment for the availability of land for Plant, Township and Ash Disposal Area has been obtained from Revenue Department, Govt. of Bihar vide letter dated 29.3.2003. Further, Central Coalfields Ltd., (CCL) vide their letter dated 29.05.03 have indicated that Central Mine Planning & Design Institute Ltd (CMPDI) have confirmed that plant location along with its other allied infrastructure are not coming on coal bearing area. |
| **1.03.00** | **WATER** | |
| | Nearest Water Source | : The project site is located near the river Sone which is the only source of water for the project. Therefore, the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage, which is about 3 kms from the proposed site. |
| | Proposed water requirement for the Stage | : 60 Cusec |
| | Proposed source / arrangement to the meet the water requirement | : The project site is located near the river Sone which is the only source of water for the project. Therefore, the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage, which is about 3 kms. from the proposed site.<br><br>The make up water requirement for the project operating on cooling towers is about 4300 cubic m/hr with ash water recirculation system and about 5900 cubic m/hr. with once through ash water system.<br><br>Water Resource Department, Govt. of Bihar, accorded in-principle clearance of 60 cusecs of consumptive water from upstream of Indrapuri Barrage vide their letter dated 06.03.03. |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|
| **1.04.00** | **COAL and WATER, Utility details:**<br>(i) Coal Quality Parameters and Fuel Oil Characteristics<br>Source:Pachra and Pachra south blocks in North Karanpura coalfields<br>Requirement: 5 MTPA<br>The Coal quality parameters and Fuel Oil Characteristics are enclosed at Table-1, & Table-2A & 2B of this Sub-Section.<br>**Water data**<br>(ii) Process water:<br>Process water quality based on COC in Table-3.<br>(iii) Clarified water:<br>Clarified water quality is indicated in Table-3.<br>(iv) DM water for Equipment cooling water system.<br>DM water quality is indicated in Table-4. |
| 1.05.00 | **Steam Generator and ESP data:** refer Table-5 |
| 1.06.00 | Drawings are enclosed as per Table-6 for initial overview to the Bidder. |
| 2.00.00 | NOT USED |
| **3.00.00** | **RAILWAY SIDING**<br>For bringing the equipment and material to the power house through rail, railway siding is proposed to be constructed from nearest railway station. |
| **4.00.00** | **METEOROLOGICAL DATA**<br>Meteorological data of the nearest observatory Dehri station is enclosed as Annexure-II to this subsection. |
| **5.00.00** | **CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**<br>All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.<br>A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for |

the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).

**Damping in Structures**

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

| | |
|---|---|
| Steel structures | 2% |
| Reinforced Concrete structures | 5% |
| Reinforced Concrete Stacks | 3% |
| Steel stacks | 2% |

**Method of Analysis**

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.

For buildings, if the design base shear ($V_B$) obtained from modal combination is less than the base shear ( $\bar{V}_B$) computed using the approximate fundamental period ($T_a$) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than $V_B$.

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I.

**Design/Detailing for Ductility for Structures**

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

| CLAUSE NO. | PROJECT INFORMATION | एनटीपीसी NTPC |
|---|---|---|

**APPENDIX – I**

## SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

1) Peak ground horizontal acceleration : 0.16g

2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra

   a) for ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.04

   b) for braced steel frames designed and detailed as per IS:800 : 0.03

   c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024

   d) for RCC chimney : 0.08
   e) for Liquid retaining tanks : 0.048
   f) for Steel chimney, Absorber tower : 0.06

   g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.04

3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.08

Note: g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

**APPENDIX – I**

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS**
**In units of 'g' for New Nabinagar project**

| Time Period | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| (Sec) | 2% | 3% | 5% |
| 0.000 | 1.000 | 1.000 | 1.000 |
| 0.030 | 1.000 | 1.000 | 1.000 |
| 0.050 | 1.750 | 1.607 | 1.443 |
| 0.100 | 3.737 | 3.060 | 2.374 |
| 0.104 | 3.904 | 3.174 | 2.443 |
| 0.123 | 3.904 | 3.401 | 2.753 |
| 0.150 | 3.904 | 3.401 | 2.753 |
| 0.200 | 3.904 | 3.401 | 2.753 |
| 0.250 | 3.904 | 3.401 | 2.753 |
| 0.300 | 3.904 | 3.401 | 2.753 |
| 0.350 | 3.904 | 3.401 | 2.753 |
| 0.400 | 3.904 | 3.401 | 2.753 |
| 0.450 | 3.904 | 3.401 | 2.753 |
| 0.500 | 3.904 | 3.401 | 2.753 |
| 0.516 | 3.904 | 3.401 | 2.753 |
| 0.550 | 3.662 | 3.401 | 2.753 |
| 0.600 | 3.357 | 3.142 | 2.753 |
| 0.607 | 3.320 | 3.105 | 2.753 |
| 0.670 | 3.006 | 2.813 | 2.493 |
| 0.700 | 2.877 | 2.693 | 2.386 |
| 0.750 | 2.685 | 2.513 | 2.227 |
| 0.800 | 2.518 | 2.356 | 2.088 |
| 0.850 | 2.369 | 2.218 | 1.965 |
| 0.900 | 2.238 | 2.094 | 1.856 |
| 0.950 | 2.120 | 1.984 | 1.758 |
| 1.000 | 2.014 | 1.885 | 1.670 |
| 1.050 | 1.918 | 1.795 | 1.590 |
| 1.100 | 1.831 | 1.714 | 1.518 |
| 1.150 | 1.751 | 1.639 | 1.452 |
| 1.200 | 1.678 | 1.571 | 1.392 |
| 1.250 | 1.611 | 1.508 | 1.336 |

**APPENDIX – I**

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS**
**In units of 'g' for New Nabinagar project**

| Time Period | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| (Sec) | 2% | 3% | 5% |
| 1.300 | 1.549 | 1.450 | 1.285 |
| 1.350 | 1.492 | 1.396 | 1.237 |
| 1.400 | 1.439 | 1.346 | 1.193 |
| 1.450 | 1.389 | 1.300 | 1.152 |
| 1.500 | 1.343 | 1.257 | 1.113 |
| 1.550 | 1.299 | 1.216 | 1.077 |
| 1.600 | 1.259 | 1.178 | 1.044 |
| 1.650 | 1.221 | 1.142 | 1.012 |
| 1.700 | 1.185 | 1.109 | 0.982 |
| 1.750 | 1.151 | 1.077 | 0.954 |
| 1.800 | 1.119 | 1.047 | 0.928 |
| 1.850 | 1.089 | 1.019 | 0.903 |
| 1.900 | 1.060 | 0.992 | 0.879 |
| 1.950 | 1.033 | 0.967 | 0.856 |
| 2.000 | 1.007 | 0.943 | 0.835 |
| 2.050 | 0.982 | 0.920 | 0.815 |
| 2.100 | 0.959 | 0.898 | 0.795 |
| 2.150 | 0.937 | 0.877 | 0.777 |
| 2.200 | 0.915 | 0.857 | 0.759 |
| 2.250 | 0.895 | 0.838 | 0.742 |
| 2.300 | 0.876 | 0.820 | 0.726 |
| 2.350 | 0.857 | 0.802 | 0.711 |
| 2.400 | 0.839 | 0.785 | 0.696 |
| 2.450 | 0.822 | 0.769 | 0.682 |
| 2.500 | 0.806 | 0.754 | 0.668 |
| 2.550 | 0.790 | 0.739 | 0.655 |
| 2.600 | 0.775 | 0.725 | 0.642 |
| 2.650 | 0.760 | 0.711 | 0.630 |
| 2.700 | 0.746 | 0.698 | 0.619 |
| 2.750 | 0.732 | 0.685 | 0.607 |
| 2.800 | 0.719 | 0.673 | 0.596 |

**APPENDIX – I**

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS**
**In units of 'g' for New Nabinagar project**

| Time Period | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| (Sec) | 2% | 3% | 5% |
| 2.850 | 0.707 | 0.661 | 0.586 |
| 2.900 | 0.694 | 0.650 | 0.576 |
| 2.950 | 0.683 | 0.639 | 0.566 |
| 3.000 | 0.671 | 0.628 | 0.557 |
| 3.050 | 0.660 | 0.618 | 0.548 |
| 3.100 | 0.650 | 0.608 | 0.539 |
| 3.150 | 0.639 | 0.598 | 0.530 |
| 3.200 | 0.629 | 0.589 | 0.522 |
| 3.250 | 0.620 | 0.580 | 0.514 |
| 3.300 | 0.610 | 0.571 | 0.506 |
| 3.350 | 0.601 | 0.563 | 0.499 |
| 3.400 | 0.592 | 0.554 | 0.491 |
| 3.450 | 0.584 | 0.546 | 0.484 |
| 3.500 | 0.575 | 0.539 | 0.477 |
| 3.550 | 0.567 | 0.531 | 0.470 |
| 3.600 | 0.559 | 0.524 | 0.464 |
| 3.650 | 0.552 | 0.516 | 0.458 |
| 3.700 | 0.544 | 0.509 | 0.451 |
| 3.750 | 0.537 | 0.503 | 0.445 |
| 3.800 | 0.530 | 0.496 | 0.439 |
| 3.825 | 0.527 | 0.493 | 0.437 |
| 3.850 | 0.523 | 0.490 | 0.434 |
| 3.900 | 0.516 | 0.483 | 0.428 |
| 3.950 | 0.510 | 0.477 | 0.423 |
| 4.000 | 0.504 | 0.471 | 0.418 |

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**6.00.00** **CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**

All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

**Damping in Structures**

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a) Welded steel structures : 1.0%

b) Bolted steel structures : 2.0%

c) Reinforced concrete structures : 1.6%

d) Steel stacks : As per IS:6533 & CICIND Model Code whichever is more critical.

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**ANNEXURE-B**

## SITE SPECIFIC DESIGN PARAMETERS

The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:

a) The basic wind speed "$V_b$" at ten metres above the mean ground level : 47 metres/second

b) The risk coefficient "$K_1$" : 1.07

c) Category of terrain : Category-2

**7.00.0 FOUNDATION SYSTEM AND GEOTECHNICAL DATA**

7.00.01 Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV.

7.00.02 The available soil data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed soil investigation for facilities under this package and shall be as per the scheme approved by owner**.**The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution.Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation.

7.00.03 The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be payable.

7.00.04 Tank Foundations

a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any.

b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III.

c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers,etc to achieve a relative density of not less than 80%.

d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.

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7.02.00 **Foundation System**

The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.

**7.02.01 General Requirements**

a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc.

b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil.

c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil.

d) No foundation shall rest on the black cotton soil.

e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost.

f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations.

g) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.

h) The water table for design purpose shall be considered at Finished Ground Level.

i) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building.

j) Foundation for equipments on ground floor

For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m2. Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications.

For equipment of static weight more than 1.5 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 1. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.

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**7.02.02** **Open Foundations**

In case open foundations are adopted, following shall be adhered to.

a) The minimum width of foundation shall be 1.0 m.

b) Minimum depth of foundation shall be 1.0m below Ground Level.

c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum.

d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.

7.02.03 Pile Foundations –

(a.) In case piles are adopted, following shall be adhered to :

i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs/conventional tripod rig. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer.

If required, temporary or permanent MS liner may be provided for piling.

ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & as enclosed in relevant annexure:

iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m.

iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval.

v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval.

vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under.

Vertical

Lateral Minimum of 2 Nos. in each mode.

Uplift

vii) The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part).

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viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter.

ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under :

i) Vertical : 0.5% of the total number of piles provided.

ii) Lateral : 0.5% of the total number of piles provided.

x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer.

xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required.

xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm.

xiii) The test load on initial test piles shall be applied by means of reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge with concrete blocks.

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xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM.

xv) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.

The procedure to carryout the test shall be submitted to the Engineer.The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner.Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile.

xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions.

xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles.

xviii) Reinforcement for job piles shall be designed as following:

(a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered.

(b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package.

**7.03.00 Special Requirements**

7.03.01 Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried

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| | out by contractor.Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly. |
| **7.04.00** | **Excavation, Filling and Dewatering** |
| 7.04.01 | For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth. |
| 7.04.02 | Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum. |
| 7.04.03 | Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils<br><br>Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices. |
| 7.04.04 | Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels. |
| 7.04.05 | CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level. |
| 7.04.06 | The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides.<br>Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches. |
| **7.05.00** | **EXCAVATION IN ROCK**<br><br>Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out. |
| 7.05.01 | Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type). |
| 7.05.02 | a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting |

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operation. All blasting shall be done as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert.

b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed.

c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials.

d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.

**7.06.00 Sheeting & Shoring**

The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.

**7.07.00 Geotechnical Investigation**

The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.

7.07.01.00 **Scheme of geotechnical Investigation**

7.07.02.01 Field test shall include but not be limited to the following:

Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc.

7.07.02.02 The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.

7.07.02.03 The minimum tests are indicated in Clause No. 7.08.00. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50.

7.07.02.04 Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers.

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**Laboratory Tests on Soil Samples**

Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement/ steel.

**Laboratory Tests on Rock Samples**

Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.

7.07.02.05 Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards.

On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc.

Recommendations on foundation system and the net allowable bearing pressures and pile capacity shall be based on the conservative values of geotechnical investigation data.

7.07.03.00 Geotechnical investigation work shall be got executed by the Contractor through the following agencies.

1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata
2. CengrsGeotechnica Pvt. Ltd, New Delhi
3. M.K. Soil Testing Laboratory, Ahemdabad
4. SECON Pvt Ltd, Bangalore
5. Soil Engineering Consultants, New Delhi
6. Orbital Infrastructure Consultancy & Research Pvt. Ltd. Cuttack
7. KCT Consultancy Services, Ahemdabad
8. ARKITECHNO Consultants (India) Pvt. Ltd. Bhubaneswar

**7.08.00 Geotechnical Investigation Scheme**

a) **Boreholes (Minimum)**

| S.N | Structure | Spacing/Number of borehole | Depth of borehole | Remarks |
|---|---|---|---|---|
| 1 | FGD | Minimum 14 Nos. | Depth of boreholes shall be 25m to 35m. | Depth of |

| | | | | |
|---|---|---|---|---|
| 2 | Crusher House | Minimum 2 Nos. | Depth of boreholes shall be 25m to 35m. | boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 25% whichever is earlier. |
| 3 | Gypsum and Lime storage area | Minimum 10 Nos. | Depth of boreholes shall be 15m to 25m | |
| 4 | Other Structure/Facility | Minimum 2 Nos. boreholes under each area / facility | 15 to 20 m | |
| 5 | Chimney | Minimum 2 Nos. | 30 to 35m | |

**b) Other Field Tests (Minimum)**

| | | | | |
|---|---|---|---|---|
| 1 | Cyclic Plate Load Test (CPLT) | 3nos | Test Depth from 2 to 4 m | |
| 2 | Trial Pit (TP) | 5 Nos. | Depth - 3 m | |
| 3 | In Situ Permeability Test In Boreholes | In minimum 3 Nos. of boreholes | Tests shall be conducted at depths of 1.0m, 3.0m, 5.0m, 8.0m and 12.0m. | |
| 4 | ERT | Minimum 10 Nos. | | |

- Depth and location of Boreholes and other field tests (PLT, ERT, field permeability tests etc.) shall be approved by Owner before execution of geotechnical investigation work.
- Investigation in any other building / structure / facilities / trestleswhich are not mentioned above shall also be carried out, if required, by the bidder for the facilities under his scope.

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**Annexure-III**

## SOIL DATA AND FOUNDATION SYSTEM

Employer has carried out geotechnical investigation in the areas near to this package. Logs of representative boreholes to be used for bidder's information in the vicinity of proposed area are enclosed with this Annexure-II. The bidder is required to carry out geotechnical investigation as per the clause no. 7.07.00 and ascertain the pile capacity and bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. Ground water table is encountered at a depth of about 11.0 to 13.0m below natural ground level (NGL) at the time of investigation. Fluctuation may occur in ground water table due to seasonal variation. The natural ground level is varying as per enclosed contour/spot level drawing.

a) The foundation system to be adopted for different structures shall be as given in Table – i below

**Table – i: Net Allowable Bearing Pressure**

| STRUCTURE | TYPE OF FOUNDATION TO BE ADOPTED |
|---|---|
| FGD and related structures | Open/Piles |

b) During design the Allowable Bearing Pressure shall be as furnished in Table-ii. Bidder is required to carry out geotechnical investigation in this area. The allowable bearing pressure shall be adopted after approval of geotechnical investigation report by owner. However, the maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to the values as furnished in Table-ii.

**Table – ii: Net Allowable Bearing Pressure**

| Structure | Founding Level in RL | Net Allowable Bearing Pressure $T/m^2$ | | |
|---|---|---|---|---|
| | | Isolated / Strip | | Rafts (width > 6m) for 75mm settlement |
| | | width upto 6 m for 25mm settlement | Width upto 6m for 40mm settlement | |
| FGD and related structures | 2.5 m below NGL | 8.0 | 9.0 | 10.0 |
| | 3.5 m | 10.0 | 12.0 | 14.0 |

| | | | | |
|---|---|---|---|---|
| | below NGL | | | |
| | 4.5 m below NGL | 12.0 | 15.0 | 17.0 |

The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.

c) Permissible Settlement of Foundations:

For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:

| | |
|---|---|
| Isolated, Strip & Raft (Mill foundations/machine foundation) | 25 mm |
| Isolated & Strip (Other than Mill foundations/machine foundation) | 40 mm |
| Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation) | 75 mm |

In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.

d) The diameter of pile, minimum length and maximum allowable capacity of piles shall be as given below:

| Area/ Location | Pile Diameter (mm) | Minimum Length of Bored Pile Below Cut-off Level (m) | Safe Load Capacity in | | |
|---|---|---|---|---|---|
| | | | Vertical Comp. (MT) | Pullout (MT) | Lateral (MT) |
| FGD and related structures | 600 | 18.0 | 140.0 | 45.0 | 7.0 |
| | 760 | 19.0 | 250 | 75.0 | 12.5 |

- Cut off Level (COL) is assumed at 3.0 m below FGL (RL(+) 127.0m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.

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e) The criteria for Pile Termination (founding level) shall be as given below:

The termination level of the pile shall be decided based on the following criterion

i) Minimum length of the pile below COL (cut off level) shall be as specified above

ii) The minimum pile length for each group of piles shall be determined based on the nearest borelog. Pile shall be socketed into yellowish weathered sand stone. A socketing length of four (4) times the diameter of the pile into rock with rock core recovery ≥ 20% shall be ensured for 600 mm & 760 mm dia piles. For pile termination, SPT 'N' values shall be used from the nearby borelog data. The boreholes are in the bidder's scope and shall be conducted as per the enclosed scheme.

iii) However, in no case the length of pile shall be less than the minimum length determined as in (i) or (ii) above whichever is longer, for that pile group.

g) Special Requirements:

i) Chemicals in ground water and subsoil, as observed during investigation are:

| Chemical | $SO_3$ | Chlorides | pH |
|---|---|---|---|
| Ground Water | 18 to 30 ppm | 50-82 ppm | 7.26 – 7.44 |
| Sub-soil | 0.011 to 0.023 % | 0.02 to 0.064 % | 7.3 – 7.62 |

ii) In view of the above, the following shall be adopted.

| | |
|---|---|
| Cement Type | As specified elsewhere in the specifications |
| Concrete Grade | As specified elsewhere in the specifications |
| Type of Reinforcement | As specified elsewhere in the specifications |
| Cover to Reinforcement | As specified elsewhere in the specifications |

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**TABLE-1**

**COAL CHARACTERISTICS**

| Sl. No. | Description | Symbol | Design Coal | Worst Coal | Best Coal | Range of Adequacy Coal |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **A.** | **PROXIMATE ANALYSIS** (As received basis) | | | | | |
| 1. | Total Moisture | % | 15.00 | 17.00 | 12.00 | 12.00-17.00 |
| 2. | Ash | % | 43.00 | 47.00 | 38.00 | 36.00-49.00 |
| 3. | Volatile matter | % | 20.00 | 18.00 | 22.00 | 25.00-15.00 |
| 4. | Fixed carbon | % | 22.00 | 18.00 | 28.00 | 37.00-17.00 |
| **B.** | **ULTIMATE ANALYSIS** (As received basis) | | | | | |
| 1. | Carbon | C% | 30.77 | 25.97 | 39.08 | 41.11-24.35 |
| 2. | Hydrogen | H2% | 3.4 | 2.85 | 3.5 | 3.60-2.87 |
| 3. | Nitrogen | N2% | 0.7 | 0.45 | 0.55 | 0.55-0.40 |
| 4. | Oxygen (By difference) | O2% | 6.2 | 5.6 | 6.07 | 6.1-5.5 |
| 5. | Sulphur | S% | 0.4 | 0.50 | 0.36 | 0.30-0.50 |
| 6. | Carbonates | CO3% | 0.50 | 0.60 | 0.40 | 0.30-0.35 |
| 7. | Phosphorous | P2% | 0.03 | 0.03 | 0.04 | 0.04-0.03 |
| 8. | Total Moisture | H2O% | 15.00 | 17.00 | 12.00 | 12.00-17.00 |
| 9. | Ash | % | 43.00 | 47.00 | 38.00 | 36.00-49.00 |
| 10. | Gross Calorific Value | KCal/Kg | 3300 | 2800 | 4000 | 4200–2700 |
| 11. | Hard grove index | | 55 | 50 | 60 | 45-65 |
| **C.** | **ASH ANALYSIS** | | | | | |
| 1. | Silica | (SiO2)% | 59.79 | 61.30 | 56.70 | 62-56 |
| 2. | Alumina | (Al2O3)% | 25.36 | 28.00 | 23.50 | 28-23 |
| 3. | Iron Oxide | (Fe2O3)% | 7.20 | 6.00 | 10.00 | 6-10 |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

| Sl. No. | Description | Symbol | Design Coal | Worst Coal | Best Coal | Range of Adequacy Coal |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. | Titania | (TiO2)% | 1.2 | 1.00 | 1.50 | 1-1.7 |
| 5. | Phosphoric Anhydride | (P2O5)% | 2.6 | 1.5 | 3 | 1-3 |
| 6. | Lime | (CaO)% | 0.88 | 0.5 | 1.50 | 0.5-1.7 |
| 7. | Magnesia | (MgO)% | 0.55 | 0.4 | 1 | 0.4-1.1 |
| 8. | Sulphuric Anhydride | (SO3)% | 1.2 | 0.5 | 1.4 | 0.5-1.7 |
| 9. | Alkalies (By Difference) | (Na2O+K2O)% | 1.22 | 0.8 | 1.4 | 0.6-0.8 |

Note: Na2O content in the above shall not be more than 0.1%

| | | | | | | |
|---|---|---|---|---|---|---|
| **D.** | **ASHFUSIONRANGE** (Under reducing atmosphere) | | | | | |
| a) | Initial Deformation Temperature (IDT) | °C | 1150 | 1200 | 1100 | 1100-1200 |
| b) | Hemispherical temperature | °C | 1350 | 1450 | 1300 | 1300-1400 |
| c) | Flow temperature | °C | 1400 | 1400 | 1400 | 1400-1450 |

**TABLE –2A**

**FUEL OIL CHARACTERISTICS**

| Sl. No. | Characteristics | Heavy Furnace Oil grade HV (HFO) IS-1593-1982 | Low Sulphur Heavy Stock (LSHS) IS-11489-1985 | Heavy Petroleum stock (HPS) IS-11489-1985 |
|---|---|---|---|---|
| 1. | Total sulphur content | 4.5% Max. | 1.0% Max. | 4.5% Max. |
| 2. | Gross calorific value (KCal/kg) | of the order of 10,000 | of the order of 10,000 | of the order of 10,000 |
| 3. | Flash Point (Min) | 66 deg C | 76 deg C | 66 deg C |
| 4. | Water content by volume (Max) | 1.0% | 1.0% | 1.0% |
| 5. | Sediment by weight (Max) | 0.25% | 0.25% | 0.25% |
| 6. | Asphaltene content by weight (Max.) | 2.5% | 2.5% | 2.5% |
| 7. | Kinematic viscosity in Centistokes | 370 at 50deg C | 100 at 100deg C | 100 at 100deg C |
| 8. | Ash Content by weight (Max.) | 0.1% | 0.1% | 0.1% |
| 9. | Acidity (inorganic) | Nil | Nil | Nil |
| 10. | Pour Point (Max.) | 57 deg C | 66 deg C | 72 deg C |
| 11. | Sodium content | — | — | 100 ppm |
| 12. | Vanadium content | 25 ppm | 25ppm | 25 ppm |
| 13. | Specific heat below pour point (KCal/Kg °C) | | 0.65 | |

| CLAUSE NO. | PROJECT INFORMATION | एनटीपीसी NTPC |
|---|---|---|

**TABLE –2B**

## LIGHT DIESEL OIL CHARACTERISTICS

## AS PER IS 1460-2000

| | Characteristics | LDO |
|---|---|---|
| 1. | Pour Point (max) | 21 deg.C& 12°C for Summer and Winter respectively |
| 2. | Kinematic viscosity in centistokes at 40 deg.C | 2.5 to 15.7 |
| 3. | Sediment percent by mass (max) | 0.10 |
| 4. | Total sulphur percent by mass (max) | 1.8 |
| 5. | Ash percentage by mass (max) | 0.02 |
| 6. | Carbon residue (Rans bottom) percent by pass (max.) | 1.50 |
| 7. | Acidity in organic | Nil |
| 8. | Flash point(Min.) - Pensky Martens | 66 deg.C |
| 9. | Copper strip corrosion for 3 hours at 100°C | Not worse than No. 2 |
| 10. | Water content, % by volume(max) | 0.25 |
| 11. | GCV (Kcal/kg) | 10,000 |

| CLAUSE NO. | PROJECT INFORMATION | एनटीपीसी NTPC |
|---|---|---|

**Table-3**

## DESIGN CLARIFIED WATER ANALYSIS

| S.No | Constituent | As | mg/l (except pH & turbidity) |
|---|---|---|---|
| 1. | Calcium | $CaCO_3$ | 131 |
| 2. | Magnesium | $CaCO_3$ | 52 |
| 3. | Sodium + Potassium | $CaCO_3$ | 65 |
| 4. | Total Cations | $CaCO_3$ | 248 |
| 5. | Chloride | $CaCO_3$ | 20 |
| 6. | Sulphate | $CaCO_3$ | 93 |
| 7. | Nitrate | $CaCO_3$ | 10 |
| 8. | Alkalinity | $CaCO_3$ | 125 |
| 9. | Total Anions | $CaCO_3$ | 248 |
| 10. | Iron(total) | Fe | 0.3 |
| 11. | Total Silica | $SiO_2$ | 22 |
| 12. | pH value | --- | 7.0-8.2 |
| 13. | Turbidity | NTU | 10 |

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dozing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

**Table-4**

## ANALYSIS OF DM WATER

| Sl.No. | Characteristics | Value |
|---|---|---|
| 1. | Silica (Max.) | 0.02 ppm as SiO2 |
| 2. | Iron as Fe | Nil |
| 3. | Total hardness | Nil |
| 4. | pH value | 6.8 to 7.2 |
| 5. | Conductivity | Not more than 0.1 μs/cm |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**Table-5**

**STEAM GENERATOR DATA**

| | | |
|---|---|---|
| 1. | Location | Outdoor |
| 2. | Operation | Base load |
| 3. | Type | Pulverised coal fired |
| 4. | Maximum Continuous Rating | 810 Tons/hr. |
| 5. | Steam pressure at SH outlet | 155 Kg/cm²(a) |
| 6. | Steam temperature at SH outlet | 540°C |
| 7. | Oil for start up and flame stabilization | Heavy Oil/LSHS/HPS/LDO |
| 8. | Fuel oil system sizing | 30% of Boiler MCR for Heavy oil/ LSHS/HPS (7.5% for LDO) |
| 9. | Pulverised coal size and 99% thru 50 mesh | Minimum 70% through 200 Mesh |
| 10. | Type of pulveriser | Vertical spindle mills |
| 11. | Type of oil burners | Steam atomised, (Air atomised for LDO) |
| 12. | No. of air heaters | Two (2) nos. of Tri-sector type |
| 13. | No. of ID Fans | Two (Radial type, both working) |

**2.00.00 ESP DATA**

| | | |
|---|---|---|
| 1. | Location: | Downstream side of Air preheaters |
| 2. | Operation: | Base load |
| 3. | Type: | Rigid Discharge frame |
| 4. | Rapping: | Intermittent |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**TABLE-6**

List of Drawings enclosed in this sub-section:

| Sl.No. | Drawing Description | Drawing No. |
|---|---|---|
| 1. | General Layout Plan | Enclosed |
| 2. | Topographical Survey | Enclosed |
| 3. | Equipment Layout Plan | Enclosed |
| 4. | ID system-Elevation & Plan | Enclosed |
| 5. | Pipe Cable Trestle Layout | Not located near FGD area |
| 6. | Pipe Cable Trestle Foundation | Not located near FGD area |
| 7. | <u>Chimney foundation details</u> | |

| | Chimney shell outer diameter at ground level (m) | Chimney foundation outer diameter (m) | Type of foundation | Level of Top of foundation (m) | Level of Bottom of foundation (m) |
|---|---|---|---|---|---|
| Unit #1&2 | 28 | 42.1 | Raft supported on piles | RL(+) 126.00 | RL(+) 122.25 |
| Unit #3&4 | 28 | 42.1 | Raft supported on piles | RL(+) 126.00 | RL(+) 122.25 |

# NTPC Limited

(A Government of India Enterprise)

# LOT 1A PROJECTS

## (PART –A)

## SECTON – VI

# TECHNICAL SPECIFICATION

# FOR

# FLUE GAS DESULPHURISATION (FGD)

# SYSTEM PACKAGE

**BIDDING DOCUMENT NO. : CS-0011-109(1A)-2**

# NTPC Limited

(A Government of India Enterprise)

# LOT 1A PROJECTS

# (PART –A)

# SECTON – VI

# TECHNICAL SPECIFICATION

# FOR

# FLUE GAS DESULPHURISATION (FGD)

# SYSTEM PACKAGE

**BIDDING DOCUMENT NO. : CS-0011-109(1A)-2**

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# FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

**BIDDING DOCUMENT NO. : CS-0011-109(1A)-2**

# LIST OF LOT 1A PROJECTS

1. PROJECT INFORMATION- KUDGI-I 3X800 MW
2. PROJECT INFORMATION- LARA-I 2X800 MW
3. PROJECT INFORMATION- GADARWARA-I 2X800 MW
4. PROJECT INFORMATION- DARLIPALLI-I 2X800 MW
5. PROJECT INFORMATION- MOUDA-II 2X660 MW
6. PROJECT INFORMATION- SOLAPUR-II 2X660 MW
7. PROJECT INFORMATION- TANDA-II 2X660 MW
8. PROJECT INFORMATION- NABINAGAR-I 3X660 MW
9. PROJECT INFORMATION- MEJA-I 2X660 MW
10. PROJECT INFORMATION- BARH-I 3X660 MW
11. PROJECT INFORMATION- NABINAGAR 4X250 MW

# LOT-IA PROJECTS

**SECTION - VI**

**TECHNICAL SPECIFICATION**
**FOR**
**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**THE TECHNICAL SPECIFICATION, SECTION - VI COMPRISE OF THE FOLLOWING PARTS**

---

## PART – A


| | |
|---|---|
| SUB-SECTION-I | INTENT OF SPECIFICATION |
| SUB-SECTION-II | PROJECT INFORMATION |
| SUB-SECTION-II-A1 | PROJECT INFORMATION- KUDGI-I 3X800 MW |
| SUB-SECTION-II-A2 | PROJECT INFORMATION- LARA-I 2X800 MW |
| SUB-SECTION-II-A3 | PROJECT INFORMATION- GADARWARA-I 2X800 MW |
| SUB-SECTION-II-A4 | PROJECT INFORMATION- DARLIPALLI-I 2X800 MW |
| SUB-SECTION-II-A5 | PROJECT INFORMATION- MOUDA-II 2X660 MW |
| SUB-SECTION-II-A6 | PROJECT INFORMATION- SOLAPUR-II 2X660 MW |
| SUB-SECTION-II-A7 | PROJECT INFORMATION- TANDA-II 2X660 MW |
| SUB-SECTION-II-A8 | PROJECT INFORMATION- NABINAGAR-I 3X660 MW |
| SUB-SECTION-II-A9 | PROJECT INFORMATION- MEJA-I 2X660 MW |
| SUB-SECTION-II-A10 | PROJECT INFORMATION- BARH-I 3X660 MW |
| SUB-SECTION-II-A11 | PROJECT INFORMATION- NABINAGAR 4X250 MW |
| SUB-SECTION-III | SCOPE OF SUPPLY & SERVICES |
| SUB-SECTION-III-A | MECHANICAL EQUIPMENTS & SYSTEMS |
| SUB-SECTION-III-A1 | FLUE GAS DESULPHURISATION SYSTEM |
| SUB-SECTION-III-A2 | AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM |
| SUB-SECTION-III-A3 | FIRE FIGHTING SYSTEM |
| SUB-SECTION-III-A4 | EQUIPMENT COOLING WATER SYSTEM |
| SUB-SECTION-III- A5 | LIME STONE & GYPSUM HANDLING SYSTEM |
| SUB-SECTION-III- A6 | ZERO LIQUID DISCHARGE SYSTEM |

| | |
|---|---|
| SUB-SECTION-III-B | ELECTRICAL SYSTEM/EQUIPMENT |
| SUB-SECTION-III-C | CONTROL AND INSTRUMENTATION SYSTEM |
| SUB-SECTION-III-D | CIVIL WORKS |
| SUB-SECTION-IV | TERMINAL POINTS & EXCLUSIONS |
| SUB-SECTION-V | SALIENT DESIGN DATA & SIZING |
| SUB-SECTION-VI | FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES |
| SUB-SECTION-VII | MANDATORY SPARES |

**PART – B (DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-I-M (MECHANICAL SYSTEM)**

| | |
|---|---|
| SUB-SECTION-I-M1 | FLUE GAS DESULPHURISATION SYSTEM |
| SUB-SECTION-I-M2 | AIR CONDITIONING & VENTILATION SYSTEM |
| SUB-SECTION-I-M3 | COMPRESSED AIR SYSTEM |
| SUB-SECTION-I-M4 | FIRE DETECTION & PROTECTION SYSTEM |
| SUB-SECTION-I-M5 | EQUIPMENT COOLING WATER SYSTEM |
| SUB-SECTION-I-M6 | LIME STONE & GYPSUM HANDLING SYSTEM |
| SUB-SECTION-I-M7 | ZERO LIQUID DISCHARGE SYSTEM |
| SUB-SECTION-I-M8 | PIPING |
| SUB-SECTION-I-M9 | MDL |

**PART – B (DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-II-E (ELECTRICAL SYSTEM)**

| | |
|---|---|
| SUB-SECTION-II-E1 | GENERAL ELECTRICAL SPECIFICATION |
| SUB-SECTION-II-E2 | MOTORS |
| SUB-SECTION-II-E3 | MEDIUM VOLTAGE BUS DUCTS |
| SUB-SECTION-II-E4 | LT POWER CABLES |
| SUB-SECTION-II-E5 | LT CONTROL CABLES |
| SUB-SECTION-II-E6 | CABLING EARTHING & LIGHTNING PROTECTION |
| SUB-SECTION-II-E7 | HT CABLES |

| | |
|---|---|
| SUB-SECTION-II-E8 | ELECTRIC ACTUATORS WITH INTEGRAL STARTERS |
| SUB-SECTION-II-E9 | HT SWTIGCHGEAR |
| SUB-SECTION-II-E10 | LT SWTIGCHGEAR & LT BUSDUCT |
| SUB-SECTION-II-E11 | DIESEL GENERATORS |
| SUB-SECTION-II-E12 | OUTDOOR TRANSFORMERS |
| SUB-SECTION-II-E13 | ELEVATOR ELECTRICAL |
| SUB-SECTION-II-E14 | FIRE PROOF CABLE PENETRATION SEALING SYSTEM |
| SUB-SECTION-II-E15 | LIGHTING |
| SUB-SECTION-II-E16 | BATTERY |
| SUB-SECTION-II-E17 | BATTERY CHARGER |

**PART – B (DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-III-C (CONTROL & INSTRUMENTATION SYSTEM)**

| | |
|---|---|
| SUB-SECTION-III-C1 | BASIC DESIGN CRITERIA |
| SUB-SECTION-III-C2 | MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) |
| SUB-SECTION-III-C3 | PROCESS CONNECTION AND PIPING |
| SUB-SECTION-III-C4 | INSTRUMENTATION CABLES |
| SUB-SECTION-III-C5 | PLC BASED CONTROL SYSTEM |
| SUB-SECTION-III-C6 | TYPE TEST REQUIREMENTS |
| SUB-SECTION-III-C7 | CONTROL VALVES, ACTUATORS & ACCESSORIES |

**PART – B (DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-IV-D (CIVIL WORKS)**

| | |
|---|---|
| SUB-SECTION-IV-D | CIVIL WORKS |

## PART – B (DETAILED TECHNICAL SPECIFICATION)

## SUB-SECTION- V-Q (QUALITY ASSURANCE)

## (MECHANICAL)

| | |
|---|---|
| SUB-SECTION-V-QM1 | FLUE GAS DESULPHURISATION SYSTEM |
| SUB-SECTION-V-QM2 | LIME & GYPSUM HANDLING |
| SUB-SECTION-V-QM3 | EQUIPMENT COOLING WATER SYSTEM |
| SUB-SECTION-V-QM4 | AIR CONDITIONING & VENTILATION |
| SUB-SECTION-V-QM5 | ZERO LIQUID DISCHARGE SYSTEM |
| SUB-SECTION-V-QM6 | COMPRESSOR AIR SYSTEM |

## (ELECTRICAL)

| | |
|---|---|
| SUB-SECTION-V-QE1 | MOTORS |
| SUB-SECTION-V-QE2 | MEDIUM VOLTAGE BUS DUCTS |
| SUB-SECTION-V-QE3 | LT POWER CABLES |
| SUB-SECTION-V-QE4 | CONTROL CABLES |
| SUB-SECTION-V-QE5 | CABLING EARTHING & LIGHTNING PROTECTION |
| SUB-SECTION-V-QE6 | HT CABLES |
| SUB-SECTION-V-QE7 | ELECTRIC ACTUATORS WITH INTEGRAL STARTERS |
| SUB-SECTION-V-QE8 | HT SWTIGCHGEAR |
| SUB-SECTION-V-QE9 | LT SWTIGCHGEAR |
| SUB-SECTION-V-QE10 | DIESEL GENERATORS |
| SUB-SECTION-V-QE11 | AUXILIARY TRANSFORMERS |
| SUB-SECTION-V-QE12 | ELEVATOR |
| SUB-SECTION-V-QE13 | VFD MODULE |
| SUB-SECTION-V-QE14 | STATION LIGHTING |

**(CONTROL & INSTRUMENTATION SYSTEM)**

| | |
|---|---|
| SUB-SECTION-V-QC1 | MEASURING INSTRUMENTS (PRIMARY & SECONDARY |
| SUB-SECTION-V-QC2 | PROCESS CONNECTION & PIPING |
| SUB-SECTION-V-QC3 | INSTRUMENTATION CABLES |
| SUB-SECTION-V-QC4 | CONTROL DESK PLC PANEL SMOKE DETECTOR FIRE ALARM & CONTROL SYSTEM |
| SUB-SECTION-V-QC5 | POWER SUPPLY SYSTEM |
| SUB-SECTION-V-QC6 | CONTROL VALVE ACTUATORS AND ACCESSORIES |
| SUB-SECTION-V-QC7 | ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS |

**(CIVIL WORKS)**

SUB-SECTION-V-QD1

**SUB-SECTION- VI**

(PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS)

**PART - C**

GENERAL CONDITIONS OF CONTRACT

**PART - D**

ERECTION CONDITIONS OF CONTRACTS

**PART - E**

LIST OF TENDER DRAWINGS

**PART - F**

ATTACHMENT-12 TO SECTION-VII (TECHNICAL DATA SHEETS)

# PART – A

# SUB-SECTION-I

# INTENT OF SPECIFICATION

| CLAUSE NO. | INTENT OF SPECIFICATION |
|---|---|

**1.00.00** **INTENT OF SPECIFICATION**

1.01.00 **Scope of the proposal**

The scope of the proposal for Engineering, Supply, Construction, Erection, Testing & Commissioning works for each project of Flue Gas Desulphurisation (FGD) System Package for Lot 1A Projects shall be on the basis of a single point responsibility, completely covering the following activities and services in respect of all the equipment specified and covered under the specifications and read in conjunction with "Scope of Supply & Services", Sub-section-III, Part-A, Section – VI of Technical Specification.

a) Basic Engineering of the plant including preparation of Plant Definition Manuals for the Project;

b) Detailed design of all the equipment and system(s) including civil, structure steel works included in bidder's scope for the Project.

c) Providing engineering drawings, equipment sizing & performance data, instruction manuals, as built drawings and other information;

d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required;

e) Complete manufacturing including shop testing/type testing;

f) Complete Civil, Structural and Architectural works, including survey, providing construction offices, field laboratory and construction equipments;

g) Packing and transportation from the manufacturer's works to the site including customs clearance & port clearance, port charges, if any.

h) Receipt, storage, preservation, handling and conservation of equipment at the site;

i) Fabrication, pre-assembly, if any, erection, testing, commissioning and completion of facilities including putting into satisfactory operation all the equipment including successful completion of initial operation;

j) Reliability tests, performance and guarantee tests after successful completion of facilities;

k) Furnishing of spares on FOR site basis;

l) Reconciliation with customs authorities, as required.

| CLAUSE NO. | INTENT OF SPECIFICATION |
|---|---|

m) Satisfactory conclusion of the contract.

n) Insurance and other requirements for the complete FGD package in accordance with the provisions of general conditions of contract (Section-IV) of the bidding document.

1.02.00 The requirements, conditions, appendices etc. given in Technical Specifications (Section-VI, Parts A, B, C, D, E & F and shall apply to and shall be considered as a part of this volume as completely as if bound here with. The work to be carried out as per the above scope shall be all in accordance with the requirements, conditions, appendices, etc., stated in Section GCC, which shall be considered as a part of the Technical Specification (Section VI ) as completely as if bound herewith. The Contractor shall be responsible for providing all material, equipment and service, which are required to fulfill the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. It is not the intent to specify completely herein, all aspects of design and construction of equipment, nevertheless, the equipment shall conform in all aspects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the Employer, who will interpret the meaning of the specification, drawings and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/or applicable international standards mentioned elsewhere in the specification.

Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specification. Before, submitting their offer, Bidder is required to visit the Project site for assessing the feasibility & layout for FGD System. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the Conditions of Contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Employer in writing before the award of this contract, based on a written request from the Bidder for such a clarification. However, if the Bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately.

The Bidder may also make alternate offers provided, such offers are superior in his opinion, to the requirements of these specifications in which case, adequate technical information, operating feed back, etc., are to be enclosed with the offer, to enable the Employer to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumption etc., shall be clearly brought out for the Employer to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications. Under no circumstances the specified equipment and services shall be brought out as an alternative offer.

| CLAUSE NO. | INTENT OF SPECIFICATION |
|---|---|
| | In case, all the above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection. |
| 1.03.00 | **The following are the equipment's covered in this specification:** |
| 1.03.01 | Wet limestone based Flue gas desulphurization (FGD) for the project, capable of reducing to the specified limits the emissions of Sulphur Dioxide in flue gas produced by specified coal being fired in boiler, complete with all accessories and auxiliary equipment's as per specification requirements including Booster Fans for each unit, Absorber for each unit with Slurry re-circulation pumps & Oxidation blowers, common Limestone Grinding & slurry preparation system, common Gypsum dewatering system, Limestone handling and storage system, Gypsum handling and storage system. |
| 1.03.02 | One (1) number of elevator for each absorber and One (1) numbers of elevator for Limestone Grinding System building. |
| 1.03.03 | Buildings for Slurry re-circulation pumps/Oxidation blowers, Limestone Grinding System, Gypsum dewatering system & FGD control Room. |
| 1.03.04 | All motors, HT & LT Switchgears, DC System, Transformers, Electrical Actuators, HT & LT power & control cables, DG set (if applicable), cabling, lighting etc. |
| 1.03.05 | ZERO LIQUID DISCHARGE (ZLD) SYSTEM for FGD waste water for Barh-I (3X660 MW) & Nabinagar (4x250 MW). |
| 1.03.06 | Low Height Wet Chimney(s) for the project. |
| 1.03.07 | Associated Control & Instrumentation (C&I) equipments. |
| 1.03.08 | Associated Civil, Structural and Architectural works including foundation as specified in Technical Specification. |
| 1.04.00 | Wherever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific items mentioned shall be understood to be descriptive only and not restrictive. Such description indicates the equipment type, function and quality desired. Other manufacturer's products may be considered provided sufficient information so as to enable the Employer to determine that the products proposed are equivalent to those named. |
| **2.00.00** | **Additional Requirements** |
| | (a) Before submitting his bid, the Bidder should inspect and examine the site and its surroundings and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other |

| CLAUSE NO. | INTENT OF SPECIFICATION |
|---|---|

circumstances which may influence or affect his offer. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Employer.

(b) Bidder shall take all necessary precautions to protect all the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to the activities of the contractor on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be immediately made good by the contractor at his own cost to the satisfaction of the Employer. The contractor shall also take all necessary safety measures with specific reference to excavation in rock, at his own cost, to avoid any harm or injury to his workers and staff from the equipment and facilities of the power plant.

(c) For his site office and covered store buildings, the contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated or uninsulated roof and wall coverings (fabricated out of permanently color coated metal sheets). Alternatively, contractor can adopt readymade 'Porta cabin' or similar construction. Contractor shall ensure that all such constructions are well engineered, neatly constructed and overall present a pleasing look.

(d) In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, contractor shall use ash and ash based products in works as specified in these specifications, drawings and as per instructions of the Engineer. He shall also use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill.

(e) Contractor shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like piling rigs, cranes batching plant, dewatering pumps etc.) In case of piling rigs, cranes, batching plant etc. he will also make arrangements / tie up with equipment manufacturers / suppliers for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Contractor shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.

**3.00.00 APPLICABLE DRAWINGS**

The drawings listed below and forming part of the specification (Refer Part-E) shall supplement the requirements specified herein. The scope and terminal points of the equipment to be furnished under this steam generator package shall be as identified in these drawings and read in conjunction with text of the specification:

| CLAUSE NO. | INTENT OF SPECIFICATION | एनटीपीसी NTPC |
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**(A) SCHEMES**

| Sl. No | Drawings Title | Drawings No. | Rev. No. | No. of Sheets |
|---|---|---|---|---|
| 1) | Scheme of Absorber system | 0011-109-POM-A-001 | A | 2 |
| 2) | Scheme of Limestone Milling system | 0011-109-POM-A-002 | A | 1 |
| 3) | Scheme of Gypsum De-watering system | 0011-109-POM-A-003 | A | 1 |
| 4) | P&ID Diagram for ECW System of FGD | 0011-109-POM-A-004 | A | 1 |
| 5) | Process Flow Diagram for FGD Waste water treatment (FGD WWT) for ZLD | 0011-109-POM-A-005 | A | 3 |

**(B) CONTROL & INSTRUMENTATION**

| Sl. No. | Drawings Title | Drawings No. | No. of Sheets |
|---|---|---|---|
| 1. | Standard configuration diagram for PLC | 0000-151-POI-A-013 | 1 |
| 2. | G.A. of Junction Box | 0000-999-POI-A-017 | 1 |
| 3. | Instrumentation cabling diagram grounding scheme for cabinets/panels/Power Supply | 0000-999-POI-A-019A | 2 |
| 4. | Scheme of 24V DC Power supply system | 0000-999-POI-A-019B | 1 |
| 5. | Scheme for Uninterruptible Power Supply System | 0000-999-POI-A-019C | 1 |
| 6. | Instrumentation/control/power supply cabling diagram | 0000-101/102-POI-A-021 | 3 |
| 7. | Instrument Source Connection details | 0000-999-POI-A-035 | 14 |
| 8. | Typical GA of Local Instrument | 0000-999-POI-A-036 | 1 |

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| Sl. No. | Drawings Title | Drawings No. | No. of Sheets |
|---|---|---|---|
| | Enclosure, purging scheme, DP transmitter | | |
| 9. | Interfacing of actuators | 0000-999-POI-A-063 | 1 |
| 10. | Interfacing of field instruments/Electrical interface/PLC Interface | 0000-999-POI-A-065 | 15 |

**(C) ELECTRICAL**

(1) Electrical single line diagram for FGD Package : Drg No. 0011-109-POE-J-001/A-E

**Note :** All the above drawings are indicative of Employer's requirements to enable the Bidder to make a suitable offer. All variations/alternations shall be clearly brought out in the technical deviation schedule with implications, if any. Such variations may be acceptable, after assessment of its implication and shall be subjected to the Employer's approval. However, the flexibility of operation and maintenance desired by the schemes and layouts shall be binding.

Electrical drawings (except Electrical single line diagram) are attached with respective Electrical Chapters in Part b, Section VI.

**4.00.00 QUALIFYING REQUIREMENTS FOR EQUIPMENTS/SYSTEMS**

4.01.00 **Provenness criteria for critical equipment, auxiliaries, systems and bought out items:**

The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:

4.01.01 Booster Fans, Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum Belt Filters for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder:

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**Type and Rating for Qualification**

| Sl. No. | Name of Equipment | Type of Equipment | Application | Equipment Rating |
|---|---|---|---|---|
| (a) | Booster Fans | Axial type with variable pitch control | Coal fired power plant | 80% of the flow & 100% of the head of the offered Booster Fan with Fan Speed 900 rpm (maximum) |
| (b) | Slurry Recirculation Pumps | Centrifugal type | Wet Limestone based FGD application in Coal fired power plant | 80% of the flow & 100% of the head of the offered Slurry Recirculation Pump |
| (c) | Oxidation Blowers | Centrifugal/ positive displacement type blower | Wet Limestone based FGD application in Coal fired power plant | 80% of the flow & 100% of the head of the offered Oxidation Blower |
| (d) | Wet limestone Grinding mills | Horizontal Wet Ball mill | Wet Limestone based FGD application in Coal fired power plant | 80% of the offered Ball mill capacity with pulverizing fineness not less than 90% thru 325 mesh |
| (e) | Slurry Pumps | Centrifugal type | Wet Limestone based FGD application or ash slurry application in Coal fired power plant | 80% of the flow & 100% of the head of the offered Slurry Pump(s) |
| (f) | Agitators | Vertical/Horizontal | Wet Limestone based FGD application in Coal fired power plant | Agitator rating not less than that supplied for 500 MW or higher size unit for similar application |
| (g) | Vacuum Belt filters | Belt type | Wet Limestone based FGD application in Coal fired power plant | 80% of the offered Vacuum Belt filter capacity |

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| | Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the bidder for the above equipment(s) is qualified.<br><br>The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 4.01.01 (a) above shall also be considered acceptable provided the rating parameters (i.e., flow, head and rated rpm) is covered within the operating regime of the respective fan performance curve of the reference plant equipment. |
| 4.01.02 | In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 4.01.01 (a) above but is a manufacturer of such equipment for units of at least 500 MW rating, the Bidder or the proposed sub vendor can manufacture such equipment for 660 MW units also, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (a) above for the Booster Fans. |
| 4.01.03 | A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.01 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).<br><br>Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later. |
| 4.01.04 | In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.01.01 (c) above but is a manufacturer of Blowers/compressors for minimum 50 $NM^3$/min capacity, the Bidder or the proposed sub-vendor can also manufacture Oxidation Blowers, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Oxidation Blowers in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (c) above for the Oxidation Blowers. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. |
| 4.01.05 | **(i)** In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.01.01 (d) above but is a manufacturer |

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of dry Grinding mills for power or cement industry of minimum 20 T/h capacity, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding mills, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Wet limestone Grinding mills in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.

In addition, the Bidder along with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for Wet limestone Grinding mills. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project.

**OR**

**(ii)** In case, the bidder or proposed sub vendor is not a manufacturer of proven Wet Limestone Grinding Mills as per clause 4.01.01 (d) above, but have designed, manufactured & supplied dry Grinding Ball Tube mills for at least 500 MW pulverized coal fired power plant, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding Mills provided it has a licensing agreement with a Wet limestone Grinding mills manufacturer who meet the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills and provides extended warranty of three (3) years for the Wet Limestone Grinding Mills. In such a case Bidder shall provide an additional on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project.

4.01.06 In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.01 (f) above but is a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry, the Bidder or the proposed sub-vendor can also manufacture Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (f) above for the Agitators. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.

4.01.07 In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.01 (e) above, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps,

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| | provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (e) above for the Slurry Recirculation Pumps. **Before** taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. |
| 4.01.08 | Before taking up the manufacturing of such equipment(s) as per clause 4.01.02, 4.01.03, 4.01.04, 4.01.05(i), 4.01.06 & 4.01.07 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licenser shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments. |
| 4.01.09 | Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified. |
| 4.01.10 | The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract. |
| | **Note to clause 4.01.01**<br>(1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite. |
| 4.02.00 | **Sub QR for Civil Works:** |
| 4.02.01 | Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels. |
| 4.02.02 | Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 4.02.01. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant. |

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| 4.02.03 | For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height. |
| 4.02.04 | In case Bidder or its agency do not meet the requirements at 4.02.01and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, earthwork in filling involving mechanical compaction and cutting in hard rock, RCC in underground storage hopper and underground tunnels ) for which it is being engaged.<br><br>Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them. |
| | **Design agency for Civil & Steel Structural Works:** |
| 4.02.05 | Bidder or its agency (ies) should have carried out the design and detailed engineering of following works:<br>(i) Civil & Structural works associated with at least one bulk material handling plant for 500 MW or higher capacity coal based/Lignite based power plant.<br>(ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height.<br>(iii) Machine foundations such as Mill foundations/ Block foundations. |
| 4.02.06 | Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 4.02.05.<br><br>The design agency (ies) proposed by the Bidder shall be subject to Employer's approval. |
| **4.03.00** | **PROVENNESS CRITERIA FOR ELECTRICAL EQUIPMENTS** |
| **4.03.01** | **HT MOTORS** |
| 4.03.01.01 | **BOOSTER FAN MOTOR**<br><br>The offered Squirrel cage Induction motor shall be from such a Manufacturer who has manufactured and supplied motor of 4MW or above rating, which should have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |

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| **4.03.02** | **LT SWITCHGEAR** |
| **4.03.02.01** | **ROUTE 1** |
| 4.03.02.01 | (i) Bidder/ Sub Vendor should have manufactured and supplied at least a total of four hundred & fifty (450) nos. draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for 1 second and 105kA peak under a single order and these panels should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| 4.03.02.01 | (ii) Bidder/ Sub Vendor should have manufactured and supplied at least one hundred & fifty (150) nos. of Air Circuit Breakers having fault rating of at least 105kA MAKING and 45kA BREAKING, and their associated draw out type Air circuit breaker panels having fault rating of at least 45kA for 1 Second and 105kA peak, which should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| **4.03.02.02** | **ROUTE 2** |
| 4.03.02.02 | (i) Bidder/Sub-vendor should have manufactured and supplied at least a total of two hundred & twenty five (225) nos. draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for 1 second and 105kA peak under a single order and these panels should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| 4.03.02.02 | (ii) Bidder/Sub-vendor should have manufactured and supplied at least seventy five (75) nos. of draw out type Air Circuit Breaker panels having fault rating of at least 45kA for 1 second and 105kA peak, which should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| 4.03.02.02 | (iii) Bidder/Sub-vendor shall Associate/Collaborate with a manufacturer who meets the requirements stipulated in Route 1. In such a case, Bidder/Sub-vendor should furnish a Deed of Joint Undertaking executed by Bidder/Sub-vendor and its Associate/Collaborator as per the format enclosed in the bidding document in which the Bidder/Sub-vendor and its Associate/Collaborator are jointly and severally liable to the Employer for successful performance of the LT Switchgears under this package. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved Sub Vendor. In case of award, the Associate or Collaborator of the Bidder / Sub Vendor (as applicable) will be required to |

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| | furnish an on-demand Bank Guarantee for INR 1 Million (Indian Rupees One Million only) **per project.**<br><br>**Note:** Each Single Front Panel shall be counted as one (1) Panel, Double Front Panel as one (1) Panel and Air Circuit Breaker Panel as one (1) Panel. |
| **4.03.03** | **11 KV / 3.3 KV SWITCHGEARS**<br><br>**Route 1** |
| 4.03.03.01 | The Bidder/ Sub Vendor should have manufactured and supplied on an average one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels per annum during the last three years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| 4.03.03.02 | The Bidder/ Sub Vendor should have designed, manufactured and supplied at least one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels complete in all respects with fault rating of at least 40kA for one (1) second and 100kA (peak), which should have been in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| 4.03.03.03 | The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers for 11kV and /or 6.6kV panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, which should have been in successful operation in 6.6kV or higher voltage application for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.<br><br>**Route 2**<br><br>Bidder/ Sub Vendor based on technological support of its Associate or Collaborator, can also participate provided |
| 4.03.03.04 | The Bidder/ Sub Vendor should have manufactured and supplied on an average one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels per annum during the last three years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| 4.03.03.05 | The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels complete in all respects with fault rating of at least 40kA for one (1) second and 100kA (peak). The Bidder/ Sub Vendor should have type tested the offered type of panels as specified. |

| CLAUSE NO. | INTENT OF SPECIFICATION |
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| 4.03.03.06 | The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers for 11kV and /or 6.6kV panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| 4.03.03.07 | Bidder's/ Sub Vendor's Associate or Collaborator meets the qualifying requirement stipulated at 4.03.03.02 & 4.03.03.03 stipulated under Route 1. |
| 4.03.03.08 | Bidder/ Sub Vendor furnishes a Deed of Joint Undertaking jointly executed by it and its Associate/ Collaborator as per format enclosed in the bidding document in which the Bidder/ Sub Vendor and its Associate/ Collaborator are jointly and severally liable to the Employer for successful performance of the MV Switchgears. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved Sub Vendor. In case of award, the Associate or Collaborator of the Bidder / Sub Vendor (as applicable) will be required to furnish an on-demand Bank Guarantee for INR 1 Million (Indian Rupees One Million only) **per project.**<br>**Note:** Equipment designed by the Bidder itself or through its Collaborator/Associate for reference plant, shall also be considered meeting the requirement of design. |
| **4.03.04** | **NUMERICAL RELAYS & NETWORKING** |
| 4.03.04.01 | Numerical Relays shall be offered from a Manufacturer who has manufactured and supplied and successfully configured at least 100 No's of Numerical Relays with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor Protections. These relays should have been in successful operation for at least one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| 4.03.04.02 | The Numerical Relay Network system shall be offered from an Integrator /Manufacturer who has designed and successfully done FAT for a network on IEC 61850 with at least 100 no's of Communicable Numerical Relays reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| **4.03.05** | **AUXILIARY OIL FILLED TRANSFORMERS** |
| 4.03.05.01 | The Bidder/ Sub-Vendor should have manufactured & supplied at least two numbers (one each at two different installations) of 16 MVA, 11KV or higher rating oil filled transformers which should have been in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |

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| | **And** |
| 4.03.05.02 | Bidder/ Sub-Vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test). |
| | **And** |
| 4.03.05.03 | 16 MVA, 11 KV Class or higher rated oil filled transformer manufactured by Bidder/ Sub-Vendor should have been successfully short circuit tested.<br>**Note**:<br>i) Two different installations mean two different project sites or two different contracts.<br>ii) Equipment designed by the Bidder/Sub-vendor by itself or through its Collaborator/Associate for reference plant, shall also be considered meeting the requirement of design. |
| **4.04.00** | **FGD WASTE WATER TREATMENT SYSTEM FOR ZERO LIQUID DISCHARGE (ZLD)** |
| **4.04.01** | **Route-1** |
| 4.04.01.01 | Bidder/Bidder's Sub vendor should have designed, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number of FGD Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser, Vapour Compressor) operating in Coal fired unit(s) of power plant, having inlet feed as FGD waste water of TDS not less than 30,000 ppm and treatment capacity of not less than 10 $m^3$/hr. The above FGD Waste Water Treatment System should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| **4.04.02** | **Route-2** |
| 4.04.02.01 | The Bidder/its Sub-vendor who do not meet the qualification requirements stipulated at 4.04.01.01 above, may also participate provided the Bidder/its Sub vendor is a contractor who have designed, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number of Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser) operating in an Industrial unit which should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder and associates/collaborates with an Associate/Collaborator who in turn fully meets the requirements stipulated at 4.04.01.01 above. |
| 4.04.02.02 | Bidder/its sub vendor should also have a valid ongoing collaboration and technology transfer agreement with an Associate/Collaborator meeting requirements of clause 4.04.01.01 above, valid minimum up to the end of the defect liability period of the |

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contract. In such a case Bidder/Sub vendor can either source the FGD Waste Water Treatment System from such system provider or can itself manufacture/get manufactured, supply and install the FGD Waste Water Treatment System as per the design, manufacturing and installation drawings released by such Associate/Collaborator.

4.04.02.03 The Bidder shall furnish a Deed of Joint Undertaking (DJU) executed by it, its Sub vendor (if applicable) and the Collaborator/Associate and each executant of DJU shall be jointly and severally liable to the Employer for successful performance of FGD waste water treatment system.

The Deed of Joint Undertaking(s) (DJU) should be submitted at the time of placement of order on approved Sub vendor. In case of award, the Associate or Collaborator of the Bidder/Sub-vendor (as applicable) shall be required to furnish an on demand bank guarantee for INR 20 Million (Rupees Twenty Million) for each project.

**4.05.00 Provenness criteria for critical equipment, auxiliaries, systems and bought out items for FGD waste water system:**

**4.05.01** The Bidder/Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:

Evaporator/Brine Concentrator, Crystallizer, Mechanical Vapour Compressor, Evaporator feed Heat exchanger, Crystalliser Heat exchanger for FGD Waste Water System for ZLD offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration/licensing agreement), manufactured/got manufactured the respective equipment(s) of the type, application and minimum equipment rating not less than that supplied in FGD waste water application and such equipment(s) should have been in successful operation in at least one (1) coal fired power station for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.

| Sl. No. | Name of Equipment | Type of Equipment | Application | Equipment Rating |
|---|---|---|---|---|
| a) | Evaporator/ Brine concentrator | Falling Film | FGD application in Coal fired power plant | Evaporator/Brine concentrator of a FGD Waste water treatment system of capacity not less than 10 $m^3$/hr. |
| b) | Crystallizer | Forced circulation | FGD application in Coal fired power plant | Crystallizer of a FGD Waste water treatment system of capacity not less than 10 $m^3$/hr. |
| c) | Mechanical Vapour Compressor | Centrifugal | FGD application in Coal fired power plant | Mechanical Vapour Compressor of a FGD Waste water treatment system of capacity not less than 10 $m^3$/hr. |

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| Sl. No. | Name of Equipment | Type of Equipment | Application | Equipment Rating |
|---|---|---|---|---|
| d) | Evaporator feed Heat Exchanger | Plate type /Tube & Shell type | FGD application in Coal fired power plant | Evaporator feed Heat Exchanger of a FGD Waste water treatment system of capacity not less than 10 $m^3$/hr. |
| e) | Crystallizer Heat Exchanger | Plate type/Tube & Shell type | FGD application in Coal fired power plant | Crystallizer Heat Exchanger of a FGD Waste water treatment system of capacity not less than 10 $m^3$/hr. |

Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the Bidder for the above equipment(s) is qualified.

**4.05.02** A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.05.01 above in India can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.05.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/his sub-vendor(s) must create/have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).

Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its Holding company/Subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/Subsidiary or upto the end of defect liability period of the contract, whichever is later.

**4.05.03** In case the Bidder or the proposed sub-vendor is not manufacturer of proven Evaporator/Brine concentrator as per clause 4.05.01 (a) above but is a manufacturer of Evaporator/Brine concentrator for any Industrial unit, the Bidder or the proposed sub-vendor can also manufacture Evaporator/Brine concentrator, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Evaporator/Brine concentrator in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (a) above for the Evaporator/Brine concentrator. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.

**4.05.04** In case the Bidder or the proposed sub-vendor is not manufacturer of proven Crystallizer as per clause 4.05.01 (b) above but is a manufacturer of Crystallizer for any Industrial unit, the Bidder or the proposed sub-vendor can also manufacture Crystallizer, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Crystallizer in India with such

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| | manufacturer who meet the requirements stipulated at clause 4.05.01 (a) above for the Crystallizer. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. |
| **4.05.05** | In case the Bidder or the proposed sub-vendor is not manufacturer of proven Mechanical Vapour Compressor as per clause 4.05.01 (c) above but is a manufacturer of Compressor, the Bidder or the proposed sub-vendor can also manufacture Mechanical Vapour Compressor, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Mechanical Vapour Compressor in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (c) above for the Mechanical Vapour Compressor. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. |
| **4.05.06** | In case the Bidder or the proposed sub-vendor is not manufacturer of proven Evaporator feed Heat Exchanger as per clause 4.05.01 (d) above but is a manufacturer of Heat exchanger, the Bidder or the proposed sub-vendor can also manufacture Evaporator feed Heat Exchanger, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Evaporator feed Heat Exchanger in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (d) above for the Evaporator feed Heat Exchanger. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. |
| **4.05.07** | In case the Bidder or the proposed sub-vendor is not manufacturer of proven Crystallizer Heat Exchanger as per clause 4.05.01 (e) above but is a manufacturer of Heat exchanger, the Bidder or the proposed sub-vendor can also manufacture Crystallizer Heat Exchanger, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Crystallizer Heat Exchanger in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (e) above for the Crystallizer Heat Exchanger. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. |
| **4.05.08** | Before taking up the manufacturing of such equipment(s) as per clause 4.05.03, 4.05.04, 4.05.05, 4.05.06, 4.05.07 above, the Bidder/its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator/licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator/licensor. Further, the Collaborator / Licenser shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments. |

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| **4.05.09** | Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified. |
| **4.05.10** | The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract. |
| | **Note to clause 4.04.00 & 4.05.00**<br>Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite. |
| **4.06.00** | **Agency for Wet Stack Flow Model Study**<br>Wet Stack Flow Model Study shall be carried out by an agency which has successfully performed at least two (2) flow model studies, in separate coal fired power plants, of wet stack installed after wet limestone based FGD Absorber (without reheating of cleaned flue gas), and based on the studies developed at least two (2) wet stack liquid collection systems which are in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. |
| **4.07.00** | **Balance equipments/ systems**<br>The Bidder at his option can source the balance of plant equipment/systems not covered in clause 4.01.00, 4.02.00**,** 4.03.00, 4.04.00, 4.05.00 & 4.06.00 above. However for such balance of plant equipment/systems, the Employer reserves the rights to satisfy himself on the provenness of the equipment and capability and capacity of the manufacturers. |
| **4.08.00** | Notwithstanding anything stated above, the Employer reserves the right to assess the capabilities and capacity of the Bidder/his collaborators/ licenser/ his sub-contractors to perform the contract, should the circumstances warrant such assessment in the overall interest of the Employer. |
| **4.09.00** | To enable the approval of sub-vendors, the Bidder shall provide all necessary data such as type, design, make, capacity, duty conditions, date of commissioning/ operation etc. |

# SUB-SECTION-II

# PROJECT INFORMATION

(CHAPTERS FOR EACH 11 PROJECTS ENCLOSED SEPERATELY)

# SUB-SECTION-III

# SCOPE OF SUPPLY & SERVICES

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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| **1.00.00** | **SCOPE OF SUPPLY AND SERVICES**<br><br>The scope of work for the equipment and accessories to be furnished in accordance with this specification shall include design, engineering, manufacture, inspection and testing at supplier's works, packing, forwarding to site, unloading, pre- assembly, assembly, erection, supervision, pre-commissioning, testing and commissioning and performance testing of the equipment/system and works indicated in this Sub-section of the technical specification. Any item or works though not specifically mentioned in this specification but needed to complete the equipment & systems to meet the intent of the Specification shall also be furnished, unless specifically mentioned under “Exclusion” in Sub-Section-IV of Part-A, Section-VI of the Technical Specifications. |
| 1.01.00 | The scope of supply & services is detailed out in the following Sub-Sections.<br><br>**Sub-Section**<br><br>III A - Mechanical equipment and associated systems<br><br>III B - Electrical Systems<br><br>III C - C&I systems<br><br>III D - Civil works |
| 1.02.00 | Scope of supply of the Contractor includes mandatory spares, start-up and commissioning spares and consumables. The general requirements in respect of various types of spares is given in Sub-Section-VII, Part-A of Technical Specification. |
| 1.03.00 | **Tests**<br><br>The scope of the Bidder includes all shop tests, type tests, site tests, routine tests, etc., fulfillment of complete quality assurance & inspection requirements and related activities for all the equipment & systems covered under the scope of work of Bidder as per the stipulations of Technical Specifications. |
| 1.04.00 | **Paints / Painting**<br><br>The Contractor's scope of work includes supply of paints and painting of all equipments and structures as per the Employer’s standard color coding scheme which shall be furnished to the Contractor during detail engineering stage. The painting of various components shall comply with the requirements stipulated in different part of this specification. However, for components where no specific requirement is stipulated, the painting conforming to the requirements stipulated below shall be provided. |

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| | (i) Surface preparation shall be blast cleaned conforming *to* Sa *2-1/2* Swiss Standard.<br>(ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.<br>(iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.<br>(iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat *of* polyurethane of minimum DFT of 25 microns shall be provided. |
| 1.05.00 | **Pre-commissioning and Commissioning Activities** |
| 1.05.01 | Contractor's Scope shall include all pre-commissioning and commissioning activities, required for successful performance of all equipments and systems under this package. Contractor's scope shall also include supply of all materials and services including the following for successful conductance of pre-commissioning and commissioning activities: |
| 1.05.02 | Complete pre-commissioning work including tests of facilities and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification. |
| 1.05.03 | Commissioning and initial operation of the facilities. |
| 1.05.04 | Supply of all consumables as may be required for above pre-commissioning/ commissioning activities |
| 1.05.05 | Supply of all temporary equipment such as piping including supports, valves, blowers and all necessary instrumentation for successful conductance of pre-commissioning and commissioning activities. All temporary equipments, blowers, valves etc. brought to sites, by the Contractor for pre-commissioning/commissioning purpose shall be in good working condition to ensure its safe and reliable operation at site. All such temporary equipments/components shall be brought to site at least three (3) months prior to commencement of relevant pre-commissioning/ commissioning activities. On receipt of the temporary equipments/components at site, the same shall be inspected by the Employer to ensure its safe and reliable operation and if in the opinion of the Employer the temporary equipments/ components are not in satisfactory conditions to ensure it's safe and reliable operation the same shall be immediately replaced by the Contractor. |
| 1.05.06 | The temporary equipments specifically brought by the Contractor solely for the pre-commissioning and commissioning work shall on completion of these activities, remain the property of the Contractor. |

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| 1.05.07 | The selection of material of all the temporary equipments/ instruments shall be compatible with the service conditions expected during pre-commissioning/ commissioning activities. |
| 1.05.08 | All temporary equipments and instruments shall be clearly listed out in the bid. |
| 1.05.09 | Supply of all labour, skilled/ semi skilled supervisors, engineers and any other manpower. |
| 1.05.10 | The scope of Contractor shall also include necessary approach & Platforms for all the instruments required during commissioning and testing. These approach platforms shall be provided to meet all required safety norms and these shall be permanent nature. |
| 1.06.00 | **First Fill of Consumables, Oils & Lubricants**<br><br>All the first fill and one year's topping requirements of consumable such as grease, oil, lubricants servo fluids etc. which will be required to put the equipments covered under the scope of specifications, into successful commissioning/initial operation and to establish completion to facilities shall be furnished by the Contractor, unless specifically excluded under the Exclusions in these specifications and documents. Limestone shall be supplied by the Employer. |
| 1.07.00 | **Guarantee Tests**<br><br>The Guarantee tests for various equipment and systems shall be carried out as specified under Sub-Section-VI, Part-A of Technical Specification. All special equipment, tools and tackles, instruments, measuring devices required for the successful conductance of Guarantee Tests shall be provided by the Contractor, free of cost. All costs associated with the tests shall be included in bid price. |
| 1.08.00 | **Spare Parts**<br><br>The Contractor's scope of supply includes all the necessary commissioning spares, mandatory spares as described Sub-Section-VII / Part-A in the schedule of spare parts. The Employer reserves the right to finalize the exact quantities of the spare parts and effect price adjustment on the basis of the rates quoted by the Contractor. The Spare ordered by Employer shall be delivered at the site as per agreed delivery schedule. |
| 1.08.01 | **Mandatory Spares**<br><br>The Bidder shall indicate the prices for each & every item (except for items not applicable to the Bidder's design) in the 'Schedule of mandatory spares' whether or not he considers it necessary for the Employer to have such spares. If the Bidder fails to comply with the above or fails to quote the price of any spares items, the cost |

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of such spars shall be deemed to be included in the contract price. The Bidder shall furnish the population per unit of each item. Wherever sets are mentioned, the Bidder has to give the item details & prices of each item

1.08.02 **Recommended Spares**

In addition to the spares mentioned above, the Bidder shall also indicate in the 'Schedule of recommended list of spare parts', his recommended list of spare with unit prices, for three years of normal operation of the plant. The Employer reserves the right to buy any or all of the recommended spare parts. The Bidder shall also indicate the service expectancy period for the spare parts under normal operating conditions before the replacement is necessary. In case some of the spares parts become unapplicable due to change in design/engineering agreed by the Employer, the Employer reserves the right to procure some other spares whose prices are already available in the initial offer in lieu of such not applicable spares subject to the condition that the total amount of the initial order remains the same.

1.08.03 **Commissioning Spares**

It will be the responsibility of the Contractor to assess and furnish a list of all commissioning spars required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Contractor within 8 months from the date of LOA, separately for each equipment and shall be reviewed by NTPC and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the Initial operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Contractor of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Contractor as a part of the respective equipment package at no extra cost to the Employer.

1.08.04 **Packing & Preservation**

Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease/lubricants from imported origin, the supplier shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Employer to procure these items from indigenous sources.

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| 1.09.00 | **Special Tools & Tackles and Test/Measuring Equipments**<br><br>One set of all special tools and tackles including testing, calibrating and measuring instruments required for erection, assembly, disassembly and maintenance of all equipments/systems covered under the scope of the Contractor shall be supplied by the Contractor. These shall not be used for erection/commissioning purposes and shall be in an unused and new condition, when they are handed over to the Employer. A list of such special tools and tackles shall be submitted along with the offer. |
| 1.10.00 | The scope of the Contractor includes complete design and engineering, technical co-ordination (including participation and arranging technical co-ordination meetings), finalization of drawings/documents, submission of engineering drawing/documents and processing of their approvals by the Employer as detailed in Part-C, Section-VI and other relevant clauses given elsewhere in the technical specification.<br><br>Further, the scope shall also include submission, in proper shape & format, of all types of manuals, handbooks & documents in requisite numbers to the Employer at different phases of the project as per the requirement of Employer. |
| 1.10.01 | Bidder shall furnish all relevant data required by the Employer, at interface points within 45 days of notification of award. |

# SUB-SECTION-III-A

# MECHANICAL EQUIPMENTS & SYSTEMS

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| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

# SUB-SECTION-III-A1

# FLUE GAS DESULPHURISATION SYSTEM

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| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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| | **SCOPE OF SUPPLY** |
| **1.00.00** | The contractor's scope of supply shall include engineering, design, manufacture, supply, erection, commissioning and testing of complete mechanical, electrical, C&I and associated civil and structural works for Flue Gas Desulphurization system and its auxiliaries for **Lot 1A Projects**, as detailed in this specification. Steam generator (in Employer's scope) shall be super-critical, balance draft, dry bottom, pulverised coal fired type. The characteristics of the coal, ash and other relevant design data is given in Part-A, Sub section-V of this specification. The FGD system shall be necessarily based on Wet Lime Stone FGD technology and is intended to reduce the emissions of Sulphur Dioxide in flue gas produced by coal being fired in boiler to the limits specified elsewhere in the technical specification. |
| 1.01.00 | Complete Electrical & Control & Instrumentation system as required for the FGD system shall be included in the scope of supply. All electrical drives and actuators required for the equipment/valves/dampers shall be in the contractor's scope. Complete Civil works, structures, foundation required for all the equipment etc. is included in the contractor's scope of work. The contractor shall also include all supporting and structural works, like pipe trestles, platforms, staircases in their scope of work. |
| 1.02.00 | The scope of supply identified for FGD system here are minimum requirements and unless specifically excluded from the contractor's scope in sub-section-V (Terminal Points and Exclusions), any equipment/system not included in this specification but integral to the system offered by the contractor to meet the intent of this specification, shall also be included in the scope of the contractor. |
| 1.03.00 | The FGD system shall have an independent absorber for each unit, common limestone milling systems and common gypsum dewatering system for each **Lot 1A** Project. The contractor shall also supply an auxiliary absorbent tank, common for the two units, for storage of absorber slurry of one unit. The contractor's scope shall include the absorbers, common limestone grinding system and gypsum dewatering system. |
| 1.04.00 | The scope of the contractor for FGD system shall include all items as shown in Tender drawings 0011-109-POM-A-001/002/003 (4 sheets). All ducting, dampers, expansion joints, pumps, valves, supports, structures etc. as required for completeness of system of absorbers, common limestone grinding system & common gypsum dewatering system shall also be in the scope of the contractor for each **Lot 1A** Project. |
| **2.00.00** | **SYSTEM DESCRIPTION** |
| 2.01.00 | The FGD system shall be based on Wet Limestone Forced Oxidation process. Each unit shall be provided with an independent absorber. |
| 2.02.00 | Gas from terminal point on ID fan discharge duct shall be taken directly to the absorber through Booster Fans. In the absorber, $SO_2$ in flue gas shall be removed by a spray of recirculating slurry, pumped by slurry recirculation pumps. Alternatively, the gas shall be bubbled through the absorber slurry to remove the $SO_2$ from flue gas. Only proven system supplied earlier by the FGD vendor shall be supplied by the contractor. |
| 2.03.00 | Compressed oxidation air shall be blown through the slurry in the oxidation tank, to oxidize the Calcium sulfite to gypsum. The oxidation system may be either grid |

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| | sparge type or lance jet type or Jet Air Sprager or any other proven system as per the practice of the FGD vendor. |
| 2.04.00 | Clean gas from the absorber shall be taken to the Wet Chimney, to be provided by the Contractor, through three stage mist eliminators. The contractor shall terminate the flue gas duct (at a suitable point on the common flue gas duct to chimney-upstream of the chimney terminal point and outside the chimney). Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper & Gate is included in the scope of the Contractor. |
| 2.05.00 | Limestone to the absorbers of the units shall be supplied by a wet limestone grinding system, common for the units. Limestone shall be fed to the Limestone day silos which in turn will feed the Limestone to wet ball mill through a gravimetric feeder. The classified limestone slurry from the mills shall be stored in two (2 no) limestone slurry storage tanks to be provided by the contractor, from where the slurry shall be pumped to the individual absorbers by dedicated limestone slurry pumps. |
| 2.06.00 | The gypsum from the absorber(s) shall be pumped by dedicated gypsum bleed pumps to a common Gypsum Dewatering system consisting of two streams (2x100%) of primary and secondary hydrocyclone and vaccum belt filters for gypsum dewatering. The water removed from the absorber shall be recycled to the absorbers. The waste water from the system shall be collected and neutralized using lime and neutralized effluent shall be pumped at required pressure to waste water terminal point as indicated in Sub-section IV, Part A of the Technical Specification. Contractor shall provide complete automated waste water neutralization system along with automated lime feeding and dosing system to ensure required pH of waste water is ensured before being discharged at the terminal point. However, for Barh-I (3X660 MW) & Nabinagar (4x250 MW) where separate ZLD system for waste water treatment is being provided by the contractor, separate waste water neutralization system is not required to be provided. Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor (in Employers scope). The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor being provided by the Employer. |
| 2.07.00 | A common auxiliary absorbent tank shall be provided for storage of absorber slurry of one absorber along with slurry pumps for pumping the slurry back to any of the absorber. |
| **3.00.00** | **LIMESTONE GRINDING AND SLURRY PREPARATION SYSTEM (COMMON FOR ALL UNITS) FOR EACH LOT 1A PROJECT** |
| 3.01.00 | The contractors scope shall include a common limestone grinding system for all the units and shall comprise of: |
| 3.01.01 | 2X100% Limestone storage silos each having minimum 24 hours storage capacity equivalent to the requirements of all the units. The storage silo shall be complete with supporting steel structure, platforms, staircase, air canons, power operated gates, gravimetric feeders, level switches, air relief devices, etc. |
| 3.01.02 | 2x100% wet horizontal ball mills with each mill sized to meet 110% of the maximum total limestone requirement of all the units at Design point. |
| 3.01.03 | Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limestone slurry storage requirement for of all the units at Design point, complete with all accessories and Agitator(s). |

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| 3.01.04 | 2x100% limestone slurry pumps for each absorber connected to each of the limestone slurry tank (total 4 nos. of pumps for 2x800 MW). Each pump catering to slurry requirement of each unit's absorber. |
| 3.01.05 | Limestone slurry piping to each absorber, along with recirculation lines, all isolation and control valves. |
| 3.01.06 | Each mill shall be fed from an independent Limestone bunker. Each mill shall be complete with the following items, as a minimum requirement:<br>i. A bunker outlet gate<br>ii. A gravimetric limestone feeder along with its drive and all other auxiliaries<br>iii. 1 no. separator tank with agitator(s).<br>iv. 2x100% Mill circuit pump.<br>v. 1 set of hydro-cyclone<br>vi. A peripheral/central drive system with motor, speed reducer gearbox and other auxiliaries.<br>vii. An auxiliary motor for inching operation with speed reducer.<br>viii. Complete lubricating system with appropriate lubricating medium storage facility (i.e. 1 no. lube oil tank for storage of lube oil and/or 1 no. grease storage drum as required).<br>ix. Lube oil pumps, coolers, duplex oil filters, connecting piping and necessary load & remote indicating instruments. Each lube oil pump and cooler shall have a 100% identical stand-by. |
| 3.01.07 | All connecting pipes / chutes along with necessary valves between various systems of the mill and from hydro-cyclone to common slurry storage tanks shall also be in the scope of the contractor. Necessary pipes, pipe supports, trestles etc. as required for the routing of the pipes shall be under the contractor's scope. Any item not included above but necessary for safe and reliable operation of the milling system proposed by the contractor shall also be in the contractors' scope. |
| 3.01.08 | The complete Limestone Grinding System shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase & one (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for easy access & movement of man/materials. etc. The building shall be sufficiently ventilated. |
| **4.00.00** | **ABSORBER SYSTEM** |
| 4.01.00 | An independent Limestone Forced Oxidation (LSFO) type absorber system shall be provided for each unit. Each absorber system shall be complete with : |
| 4.01.01 | Absorber tower complete with re-circulating slurry spray header(s) and nozzles, three stage mist eliminators, wash water nozzles, oxidation tank integral to tower, oxidation headers and nozzles, and agitators and all internal systems integral to the working of the absorber. |

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| 4.01.02 | 2x100% re-circulating slurry pump for each level of spray. Alternately, the contractor may offer a spare level of spray with each spray level served by an independent 100% pump. In case the contractor offers a single level of spray, one number of standby pump of the same capacity & head as the working slurry recirculation pumps shall be provided.<br><br>(In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No re-circulating pump and spray header and nozzles shall be required in such case.) |
| 4.01.03 | Complete Ducting System from ID fan common outlet duct to absorber tower & from absorber outlet to wet stack chimney. |
| 4.01.04 | 2x100% Centrifugal/ positive displacement type oxidation blowers / compressors. |
| 4.01.05 | 1 No. Emergency water tank for spraying water at inlet of Absorber for upset condition. |
| 4.01.06 | All connecting piping and valves required by the system. |
| 4.01.07 | 2x100% gypsum bleed pumps. |
| 4.01.08 | Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves. |
| 4.01.09 | Routing of the duct/piping system complete with supports, structures, trestles, absorber platforms, as required shall be in the contractor's scope of supply. |
| 4.01.10 | Passenger cum Goods elevator for each Absorber of minimum capacity of 1000 kgs. |
| 4.01.11 | All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers shall be in straight line. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc. The building shall be sufficiently ventilated. |
| **5.00.00** | **GYPSUM DEWATERING SYSTEM** |
| 5.01.00 | The employer envisages a common gypsum dewatering system for all the units. The common dewatering system shall receive the gypsum slurry from each absorber through slurry feed pipes and shall comprise of two sets of dewatering equipments. |
| 5.02.00 | Each set (suitable for handling /dewatering of all the unit) of dewatering equipment (01 working set + 01 standby set) shall comprise of the following items as a minimum requirement:<br>i. One set of primary hydro-cyclones<br>ii. One vacuum belt filter<br>iii. One no. vacuum receiver<br>iv. One no. vacuum pump<br>v. One set of secondary hydro-cyclones<br>vi. Complete piping and valves for the system along with wash water line. |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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| 5.03.00 | This system shall be comprising of 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the units operating simultaneously at Design Point, with any range of limestone specified. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification. |
| 5.04.00 | The filtrate water from belt filter dewatering and wash water from washing system and the under flow from the secondary hydro-cyclone shall be taken to a common filtrate water tank. 2x100% pump shall be provided to supply wash water (for cake washing as well as belt cloth washing) to the belt filters. In addition, 2x100% Filtrate water pump (common for all units) shall be provided to recycle the filtrate to the absorber. The contractor shall include the necessary piping and valves in their scope. |
| 5.05.00 | The gypsum slurry from each Absorber shall be fed to a common Primary hydro cyclone feed tank (sized for minimum 1 hr storage capacity) from where it will be fed to each primary set of hydro-cyclone through 2x100% Primary hydro cyclone pumps. The overflow from the primary set of hydro-cyclone shall be taken to a common Secondary hydro cyclone feed tank. 2x100% Secondary hydro cyclone pumps shall be provided to feed 2x100% secondary hydro-cyclones. The underflow from the primary hydro-cyclone shall be fed to the 2X100% vacuum belt filter system. |
| 5.06.00 | The under flow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water neutralization system to be provided by the Contractor. The waste water system shall be complete with lime feeding & storage system, neutralization tank, waste water tank, 2x100% waste water pumps along with complete piping, instrumentation, valves, piping support etc. to discharge waste water at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the Technical Specification. All the piping with supports, trestles as required shall be in the contractors' scope. The contractor shall also include any other item not included above but necessary to make the system complete. |
| 5.07.00 | The complete Gypsum Dewatering System shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways for easy access & movement of man/materials etc. The building shall be sufficiently ventilated. |
| **6.00.00** | **AUXILIARY ABSORBENT TANK** |
| 6.01.00 | The employer shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. |
| 6.02.00 | The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.). All agitators, piping, valves, fittings and other structures required for the system shall be included in the scope of the contractor. |
| **7.00.00** | **PROCESS WATER & COOLING WATER STORAGE & PUMPING SCHEME (FOR 2X800 MW)** |
| 7.01.00 | Two (2) Process water Storage tanks (each tank catering to the requirements of all the units) along with two numbers of 2x100 % Booster water pumps, if required, |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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| | (Each pump catering to the process water requirements of all the units) along with all necessary piping, valves, control & instrumentation to feed the tank from terminal point. Process water Storage level is automatically controlled at operating level by controlling the water flow from the Cooling Tower Blow down System from terminal point. The two tanks shall be interconnected with an isolation valve. |
| 7.01.01 | 2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. |
| 7.02.00 | 2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to mist washing requirement of one unit. Alternatively, Contractor can use process water pumps for mist eliminator washing if it is the standard & proven practice of the Contractor or its Technology Collaborator. |
| 7.03.00 | One (1) clarified water Storage tanks (each tank catering to the clarified water requirement for all the units) along with two numbers of 2x100 % clarified Booster water pumps (Each pump catering to the clarified water requirements for all the units) from terminal point. |
| 7.04.00 | 2x100% cake washing Pumps for each Vacuum Belt Filter. |
| 7.05.00 | 2x100% cloth washing Pumps for each Vacuum Belt Filter. |
| 7.06.00 | Any other pump or storage system not specified but required to meet the system requirement shall be provided by the contractor with the approval of the Employer. |
| 7.07.00 | All drains & overflow lines from the tanks shall be terminated to the nearest trench/drain. |
| 7.08.00 | All the storage tanks shall be lined with vinyl ester based flake glass lining from inside. |
| **8.00.00** | **SUMP & SUMP PUMPS** |
| 8.01.00 | The contractor shall provide sumps of adequate capacity in each of the following area:<br>A. Each Absorber Area<br>B. Limestone Grinding system<br>C. Gypsum dewatering system<br>Waste water which might be generated during flushing and cleaning procedures of the equipment shall be collected in the sump and shall possibly be reused in the wet absorber. |
| 8.02.00 | The contractor shall provide agitators and sump pumps of required capacity in each of this area along with necessary pipes, isolation / control valves etc for pumping back the water in the sump into the respective system. The Interior surface of the Sumps shall be lined with replaceable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness. |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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| 9.00.00 | **Elevator** |
| 9.01.00 | One (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for each Absorber (to be provided in case height of absorber is higher than 20m) and One (1) number passenger cum goods elevator of minimum capacity of 1000 kgs in Limestone Grinding System Building shall be provided for easy access & movement of man/materials. |
| 9.02.00 | The scope shall include all items / accessories, service along with all electrical equipment etc. required to meet all design, installation, operation, safety, protection and other requirements of IS: 14665 (latest edition) (all parts), 'Lift' and service lifts'. This scope shall include all items / devices needed to comply with the requirements indicated elsewhere in the specification. The scope shall include provision of fireman's switch. |
| 9.03.00 | One (1) nos. adequately sized, Air conditioners each having minimum cooling capacity of 2.5 Ton shall be provided for each elevator machine room to make it dust proof. |
| 9.04.00 | Complete erection, testing and commissioning including all testing and commissioning materials, consumables and other tools and tackles required for erection. |
| 9.05.00 | To obtain necessary local administration permits / approvals and make arrangements for inspection and tests required thereby. |
| 10.00.00 | **Thermal Insulation, Lagging, Cladding & Refractories** |
| | Thermal Insulation alongwith aluminum cladding, lagging, reinforcement wiremesh, cleats and supports, shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius. The insulation thickness shall be designed based on criteria specified in Part-B, Section-VI. |
| 11.00.00 | **Buildings** |
| 11.01.00 | Contractor shall provide buildings for Limestone Grinding System; Slurry re-circulating pumps & Oxidation blowers / Compressors; Gypsum Dewatering System & FGD control room & Analyser room (if required). The buildings must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipments of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc. |
| 12.00.00 | Contractor shall provide Corrosion protection painting for structures & equipments as described in the specification |
| 13.00.00 | Contractors scope shall include all Platforms, walkways, staircase, safety rails for access of each equipment, valves, dampers, gates, instruments etc. handling facilities adequately each component of FGD system. |
| 14.00.00 | The contractor scope shall also include the provision of FGD trestle for routing of air & water lines, slurry lines, steam line, waste water, etc.. required for the complete process operations. |
| 15.00.00 | Contractor shall provide air conditioning for the FGD control room and Analyser room (if separately provided) & ventilation for the FGD system buildings as detailed in Sub-Section III-A2. |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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| 16.00.00 | Contractor shall provide compressed air system for the FGD system as detailed in Sub-Section III-A3. |
| 17.00.00 | Contractor shall provide FIRE FIGHTING SYSTEM as detailed in Sub-Section III-A4. |
| 18.00.00 | Contractor shall provide EQUIPMENT COOLING WATER SYSTEM as detailed in Sub-Section III-A5. |
| 19.00.00 | Contractor shall provide Limestone & Gypsum handling & storage system for FGD as detailed in Sub-Section III-A6. |
| 20.00.00 | Contractor shall provide ZERO LIQUID DISCHARGE SYSTEM for FGD waste water for Barh-I (3X660 MW) & Nabinagar (4x250 MW) as as detailed in Sub-Section III-A7. |
| 21.00.00 | The scope of civil works shall be as per Sub-Section-III D. |
| 22.00.00 | Associated Electrical and Control & Instrumentation systems for FGD as detailed in Sub-Section-IIIB & Sub-Section-IIIC respectively of Part-A/Section-VI of this specification. |
| **23.00.00** | **Booster Fan & Isolation Gates** |
| 23.01.00 | For each unit, two (2) nos. Booster Fans of axial type, Constant speed, variable pitch controlled each with drive motor, base plates, foundation bolts and nuts, inlet box, discharge case, coupling, coupling guard and suitable arrangement to prevent rain water entry to fan motor. Each Booster Fan shall be provided with bearing lubrication and hydraulic blade pitch control unit(s) consisting of<br>(1) 2x100% oil pumps each with motor, coupling and coupling guard.<br>(2) 2x100% oil coolers.<br>(3) 2x100% filters, differential pressure switches, etc.<br>(4) One (1) oil storage tank.<br>(5) Instrumentation, vibration monitoring, inter connected piping, valves and fittings including pressure relief valves and non return valves.<br>(6) Electrical actuator with accessories etc.<br>Alternatively, a forced oil lubrication system (consisting of 1to 6 above ) common to bearing lubrication and for servo motor operation to each BF Fan will also be acceptable.<br>At least two (02) nos. of duplex thermocouples or duplex platinum RTDs (100 ohm at $0^{o}C$) and one no. of temperature indicators shall be provided for bearing metal temperature measurement, control and monitoring.<br>Booster fans shall be suitable for the type of foundation being provided. |
| 23.02.00 | Motorized Guillotine type gates with 2x100% seal air fans shall also be provided at suction & discharge of each Booster Fan. The Gates shall be designed for tight shut-off. The design of the gates shall ensure 99.95% leak tightness without seal air. The gates shall be 100% leak tight with seal air fans under the above conditions. |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
|---|---|
| 24.00.00 | Contractor shall provide Low Height Wet Chimney(s) as per the criteria & specifications specified elsewhere in the specification for the project. |
| 25.00.00 | **Wet Stack Condensate Collection System** |
| 25.00.01 | Wet stack of 150 metre height shall be provided with a stack condensate collection system to avoid the carryover of the condensate/acidic dews/water droplets/Gypsum coming out of the stack. Design of the wet stack condensate system should be such that all the condensate are collected in the stack itself and no water droplet/condensate come out of the chimney and preventing falling of the acidic dews/water droplet/gypsum from the chimney in the plant/nearby area. |
| 25.00.02 | Drain piping shall be of suitable material from corrosion point of view. |
| 25.00.03 | All Stack liquid collection shall be easily accessible for O&M. |
| 25.00.04 | The design of the stack condensate collection system shall be provided by the bidders in its bid. |
| 25.00.05 | A common Nickel based alloy material storage/neutralizing tank for the both the units of storage capacity of 12 hrs of stack condensate of both the stack shall be provided. Storage tank/neutralization tank shall be complete with dosing, mixing and preparation system. After neutralization of the stack condensate collection, same shall be pumped to common drain system. Contractor shall provide 2 X100% pumps, complete with valves, piping fittings, level control/monitoring etc. Alternatively, bidder may propose its proven system for disposal of the condensate system in its bid for Employer's consideration. All the material in contact with the condensate shall be of suitable material for the operating duty. |
| 25.00.06 | Stack outlet liquid collector shall be designed in such a way so that the liquid condensate film near the exit of the stack is collected instead of carrying with the exit gas. Bidders shall provide all these details in its bid. |

# SUB-SECTION-III-A2

# AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM

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| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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**1.00.00** **AIR CONDITIONING SYSTEM**

**a) General**

The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Air conditioning system consisting of D-X units with refrigerant piping & valves, Air handling units, Hi-wall split air conditioner /Cassette Air conditioners, Packaged Air Conditioners, Fresh air fans, air distribution system (ducting, filters, isolation dampers, motorized fire dampers, diffusers, grills, volume control dampers, etc.) etc., along with all electrical equipment and instrumentation as required for all the buildings which are in the scope of the bidder, as detailed out in Part-B of Section-VI.

b) **Air-conditioning system for F.G.D Control Room Building and ZLD control room building (if provided)**

Air cooled condensing units (D-X type) type air conditioners with AHU of suitable capacity with 100 % redundancy ( as per actual heat load calculation ) shall be provided .

c) SO2 analyzer room (if required) and other air conditioned offices/areas covered under this package shall be provided with Ductable/Non ductable Split air conditioners etc. as per Design criteria specified in Chapter Salient Design Data. Non ductable Split air conditioner shall conform to minimum three (3) star (***) rating and above of latest version of Bureau of Energy Efficiency (BEE) HVAC code issued by Ministry of Power, Govt of India.

d) Supply of Mandatory spares as specified.

e) Any additional items required to make the system complete.

f) For Air conditioning system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition acceptable to the Employer. The Bidder shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications.

g) Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning system as per manufacturer's standard practice. However relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall be made available in FGD/ ZLD control system. Control and monitoring of air conditioning system from FGD/ZLD control system is also acceptable.

h) Apart from the above, any area/building which are in the scope of the bidder and require air conditioning, the same shall be provided with air conditioning system, as detailed out in Part-B of Technical Specification.

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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| 1.02.00 | **Redundancies of equipments:**<br><br>100% standby unit shall be kept for FGD/ZLD control room, SO2 analyzer room (if required) and other air conditioned offices/areas. |
| **2.00.00** | **VENTILATION SYSTEM** |

a) **General**

The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Ventilation system consisting of Modular type Unitary air filteration Units, Supply air fans, water pumps, exhaust air fans, louvers, filters, ducting, diffusers, piping, instrumentation etc., for all the buildings which are in the scope of the bidder, as detailed out in Part-B of Section-VI.

b) **Non-A/C areas of F.G.D Control Room Building and ZLD control room building (if provided)**

**Minimum** One (1) nos. of Evaporative type Unitary Air Filtration (UAF) unit (of metallic construction- modular type) of suitable capacity with all accessories, DIDW centrifugal fan (1 x 100%), circulating water pump (1 x 100%), etc. as detailed out in technical specification shall be provided.

c) **Miscellaneous areas:** All other areas like Limestone Grinding system building, Gypsum dewatering building, Recirculation pump & Oxidation blower/compressor building etc & all other non-air conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers. For ventilation of Battery rooms and Oil rooms, fans with flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans.

d) Supply of Mandatory spares as specified.

e) Any additional items required to make the system complete.

f) For Ventilation system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition acceptable to the Employer. The Contractor shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications.

g) Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of ventilation system as per manufacturer's standard practice. Control and monitoring of ventilation system from FGD /ZLD control system is also acceptable.

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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| **3.00.00** | **COMPRESSED AIR SYSTEM**<br>a) Two (2) numbers (1 working+ 1 standby) oil free, rotary screw type air compressors for Instrument air and service air applications for FGD and ZLD plant (if provided) each of adequate capacity & adequate pressure, with their motor drives and other accessories as per equipment sizing criteria mentioned in Part A, Sub-section 'Salient design data' of technical specification. However, minimum capacity of each air compressor shall be 15$Nm^3$/min at discharge pressure of 8.5 $Kgf/cm^2$ (g).<br>b) Two (2) numbers (1 working+ 1 standby) Air Drying Plants (one for each air compressor) of adequate capacity with all interconnecting piping, valves, fittings, etc.<br>c) Two number Air Receiver each of capacity 2 $m^3$ (normal) at the discharge of each Air compressor.<br>d) One number Air Receiver of capacity 2$m^3$(normal) for ZLD plant if ZLD plant is far away from compressor location.<br>g) Monorail with Chain pulley block of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more.<br>h) Complete instruments, control system with panels as required for compressed air system.<br>i) Complete compressed air and piping network for service air and instrument air application in FGD and ZLD system (if provided).<br>j) Supply of Mandatory spares as specified.<br>k) Any additional items required to make the system complete. |
| **4.00.00** | **General**<br>i. All associated Civil & structural work for air conditioning and Ventilation system and compressed air system.<br>ii. Set of commissioning spares as may be required during erection and commissioning.<br>iii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C & I equipment under the scope of bidder.<br>iv. All steel / cast iron inserts, plates, bolts, nuts, sleeves, metallic-fasteners etc. to be grouted in concrete work and used to hold/ support the equipment/piping / ducting being supplied and erected under this specifications.<br>v. Any additional items required to make the system complete.<br>vi. Initial charge of all lubricants and grease, etc. Further, all consumables required for PG tests shall also be in Bidder's scope of supply. Grouting, dressing and final finishing of all foundations of various equipment, etc. |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
|---|---|
| | vii. Repairing and making good/ sealing of cutouts / openings in floors, roofs and walls, for executing the works under this system and making them water tight as directed by the engineer.<br><br>Corrosion protection painting for all equipment / items by Bidder as detailed in relevant clauses of technical specification. |

# SUB-SECTION-III-A**3**

# FIRE FIGHTING SYSTEM

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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**1.00.00 FIRE DETECTION AND PROTECTION SYSTEM:**

The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Fire Detection and Protection System for FGD area. Following system has been envisaged:

**1.1 Hydrant System:**

Complete hydrant system (pipe, hydrant valves, landing valves, water monitors, hoses, branch pipes and nozzles etc) for FGD area shall be provided as per TAC norms. Tapping for hydrant system shall be provided from nearby existing hydrant header.

**1.2 HVW Spray System:**

Automatic fire detection cum high velocity water spray system shall be provided for various transformers (having oil capacity 2000 liters or more) envisaged under this package. Tapping for HVW spray system shall be provided from nearby existing hydrant header.

**1.3 MVW Spray System:**

Automatic fire detection cum medium velocity water spray system for the various cable galleries envisaged under this package. Tapping for MVW spray system shall be provided from nearby existing Spray header.

**1.4 Fire Extinguishers**

Five numbers each type of Portable fire extinguishers consisting of water type, dry chemical powder type, CO2 type shall be provided in various facilities of FGD system.

**1.5 Analogue addressable type Fire Alarm System / Annunciation Panels:**

Analogue addressable type Fire Alarm System consisting of Multi sensor type detectors, Linear Heat Sensing Cable (LHSC) detector, cabling, junction boxes, instrumentation, Fire Alarm cum control panels, repeater panels, etc. for various areas/equipment as detailed out below:-

a) All MCC / switch gear room / Control room shall be provided with Multisensor type detectors.
b) All Conveyors and Cable Galleries shall be provided with Linear Heat Sensing Cable detectors.
c) All cable galleries shall be provided with Multisensor type detectors.

**1.6** The Contractor is responsible for getting the complete approval of the system elaborated in this specification from TAC accredited professional(s).

**1.7** If the contractor feels, it is necessary to include any other items, which, in his opinion, may be required to comply with TAC regulations, other than those indicated in the specification, the same shall also be supplied, erected and commissioned. Any amendments, modified rules to the latest TAC regulations till techno-commercial bid opening date should be considered by contractor to fulfill the above condition.

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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**1.8** Successful contractor shall furnish complete hydraulic calculation.

**1.9** Supply of complete mandatory spares as specified elsewhere.

**1.10** Set of commissioning spares as may be required during erection and commissioning.

**1.11** One (1) set Special tools and tackles required for maintenance of all the mechanical, electrical and C & I equipment under the scope of Contractor.

**1.12** Any additional item/ equipment required to make the system complete.

**1.13** Grouting, dressing and final finishing of all foundations of various equipment, etc.

**1.14** Supply of structural supports for piping in trench and for above ground piping wherever applicable.

**1.15** Supply & application of protective coatings and wrapping for buried pipes and pipes in RCC trenches, and painting for above ground piping, valves, pipe supports, etc. as detailed in technical specifications.

**1.16** Excavation, preparation of bed, laying, backfilling with compaction of soil for all underground/buried piping. Also, breaking and re-erection of paving for buried piping (if any)

**1.17** Preparation of necessary detailed drawings including schematics, layouts, isometrics, fabrication drgs, erection drgs, etc. as required and also development of “As Built Drgs”.

**1.18** Conductance of Performance and Guarantee test as per Standard Guaranteed test procedure given elsewhere in the specification.

**1.19** All pylons required for transformers, shall be anchored to soak pit base slab of individual transformer, paved area outside soak pit, etc. using anchor fasteners of adequate capacity. Subsequent to fixing the pylons, lower part of pylon which would be within filled up gravel portion shall be encased with concrete by Employer for corrosion protection.

# SUB-SECTION-III-A**4**

# EQUIPMENT COOLING WATER SYSTEM

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| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
|---|---|

**EQUIPMENT COOLING WATER SYSTEM**

**(FOR NABINAGAR - 3 X 660 MW & BARH-I(3 X 660 )**

1.00.00 **SCOPE**

1.01.00 **Equipment Cooling Water System**

The Bidder shall provide common Equipment Cooling water system for all three units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification.

(a) One cold water header tapped from CW Blowdown from CW pump discharge pipe.

(b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water.

(c) 2x100% capacity self cleaning strainers on the secondary side.

(d) 4 x 33.33% (3 working + 1 standby) capacity of plate type heat exchangers.

(e) 5 x 33.33% ( 3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives.

(f) 4 x 33.33% ( 3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.

(g) One Overhead DM water tank (ECW O/H tank).

(h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc.

(i) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
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**EQUIPMENT COOLING WATER SYSTEM**
**(FOR NABINAGAR TPP- 4 X 250 MW)**

1.00.00 **SCOPE**

1.01.00 **Equipment Cooling Water System**

The Bidder shall provide common Equipment Cooling water system for all four units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification.

(b) One cold water header tapped from CW Blowdown from CW pump discharge pipe.

(b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water.

(c) 2x100% capacity self cleaning strainers on the secondary side.

(d) 5 x 25% (4 working + 1 standby) capacity of plate type heat exchangers.

(e) 6 x 25% (4 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives.

(f) 5 x 25% (4 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.

(g) One Overhead DM water tank (ECW O/H tank).

(h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc.

(ii) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
|---|---|

**EQUIPMENT COOLING WATER SYSTEM**
**(FOR LARA STPP- 2 X 800 MW,KUDGI-2 X 800 MW,GADARWARA -2 X 800 MW,DARLIPALI-2 X 800 MW,MOUDA –II 2 X 660 MW,TANDA-II -2 X 660 MW,MEJA-2 X 660 MW,)**

1.00.00 **SCOPE**

1.01.00 **Equipment Cooling Water System**

The Bidder shall provide common Equipment Cooling water system for all two units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification.

(a) One cold water header tapped from CW Blowdown from CW pump discharge pipe.

(b) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water.

(c) 2x100% capacity self cleaning strainers on the secondary side.

(d) 3 x 50% (2 working + 1 standby) capacity of plate type heat exchangers.

(e) 4 x 50% (2 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives.

(f) 3 x 50% (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.

(g) One Overhead DM water tank (ECW O/H tank).

(h) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc.

(iii) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

# SUB-SECTION-III- A**5**

# LIME STONE & GYPSUM HANDLING SYSTEM

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| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

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**1.00.00 INTENT OF SPECIFICATION**

This specification is intended to cover the following activities and services in respect of all the equipment of **Lime Stone Handling Plant & Gypsum Handling plant** to be installed for **FGD Package**, completely covering the following activities and services in respect of all the equipment specified and covered under the specifications and read in conjunction with "Scope of Supply & Services", Part-A, Section–VI of Technical Specification.

(i) Detailed design and engineering of all the equipment and equipment system(s).

(ii) Complete manufacture including shop testing/ type testing.

(iii) Providing engineering data, drawings, Commissioning procedures and O & M manuals, etc. for the Employer's review, approval and records.

(iv) Packing and transportation from the manufacturer's works to site including transit insurance, customs clearance/ port clearance, if required.

(v) Receipt, unloading, storage, preservation, conservation and insurance of equipment at site.

(vi) Fabrication, pre-assembly, (if any), erection, testing and putting into satisfactory operation of all the equipment including successful completion of facilities.

(vii) Associated civil, structural, architectural and electrical works.

(viii) Commissioning and completion of facilities and Performance Guarantee Tests after successful completion of initial operation.

(ix) Furnishing of spares on FOR site basis and handing over to NTPC stores.

(x) Reconciliation with custom authorities, if applicable.

(xi) Satisfactory completion of the contract.

1.01.00 Before submitting his bid, the Bidder should inspect and examine the site and its surroundings and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Employer.

1.02.01 Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed Layout submitted with the bid. ***In the absence of this, the bid shall be deemed incomplete and may be liable for rejection***.

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| 1.02.02 | NTPC reserves the right to freeze a basic layout for each NTPC plant post techno commercial bid discussions. |
| 1.03.00 | The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to fulfill the intent of ensuring operability and the reliability of the complete system covered under this specification. |
| 1.04.00 | Cleaning of any debris produced by the bidder during erection and commissioning shall be done immediately at each front by the bidder. |
| 1.05.00 | Bidder to extend all help and documentary support for compliance and addressing any statutory issues raised at site which pertains to the area/ work under bidder's scope. |
| **2.00.0** | **DETAILED SCOPE** |
| **2.01.00** | **Limestone Handling Plant (LHP)** |
| 2.01.01 | Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes.<br><br>**Lime stone received through Road** shall be unloaded by Two (2) numbers Truck Tipplers each of minimum 20T capacity to discharge Limestone on to Box Feeders/ Surface Feeders/ Truck Unloading Hopper, complete with all mechanical, electrical and C&I, civil & structural works for unloading Limestone by truck tipplers.<br><br>Two (2) numbers Box Feeders/ Bulk-material Receiving Unit/ Underground Truck Unloading Hopper / Surface feeder, for unloading of limestone from trucks/ self-tippling trucks/ loader shovels, complete with drives, accessories all mechanical, electrical and C&I, Civil & structural works, including its supporting foundations etc. This unit shall feed limestone onto the conveyor before Limestone crusher house.<br><br>**Limestone received through Indian Railway Rakes** will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house through series of new conveyors/bucket elevators. All necessary modifications involving Mechanical, Electrical, C&I, Civil and Structural works in the existing CHP for taking feed to new limestone path shall be in the scope of the bidder. |
| 2.01.02 | Limestone shall be conveyed to usage point through double stream of capacity 100% each for conveying & crushing. |
| 2.01.03 | Lime stone Belt Conveyors / Bucket Elevator complete with associated tunnel, conveyor galleries along with its supporting structures, short supports, stringers, deck plate, seal plate, conveyor foundations, drive motors, drive units, pulleys, idlers, gravity take ups including guides, pits etc., internal and external belt cleaners, pull chord switches, belt sway, zero speed switches, electro-hydraulic thruster brakes, all electrical etc. including all civil, structural and architectural works for tunnel, conveyor gallery, gallery supporting trestles and their associated foundations, as applicable. |
| 2.01.04 | One (1) number Lime stone crusher house (CH) complete with all civil, structural, architectural and electrical works etc. accommodating suitable nos. crushers and |

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| | associated Vibrating feeders, R&P and Rod gates etc., passenger cum goods elevator, conveyors, chute work along with actuator operated flap gates, monorails & hoists, hoist maintenance platform, external and internal staircases, hand rails and other equipment such as sampling unit, dust extraction system etc. as specified elsewhere. |
| 2.01.05 | Suitable numbers of vibrating feeders in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc. |
| 2.01.06 | Suitable numbers of hammer crusher complete with drives, accessories all mechanical, electrical civil & structural works, including crusher supporting foundations, vibration isolation system with springs and viscous dampers, vibration monitoring system etc. |
| 2.01.07 | Crushed limestone Reclaim Hopper (RH) /Silo, machinery hatches at each of end of limestone storage shed for RH, fully / partially underground or over ground junction towers, tunnels and pent houses, complete with civil, structural, architectural, electrical and C&I works including over ground structural shed for entire length of limestone ground storage and machinery hatches, removable chequered plate covers over openings in machinery hatches for handling underground equipment like paddle feeders etc. (as applicable). For Limestone storage shed and for all buildings, other equipment such as DS system, ventilation system, drinking water system, drainage system etc. as specified elsewhere in the specification. |
| 2.01.08 | Junction towers (along with underground / over ground RCC structures), tunnel/conveyor gallery / bucket elevator complete with all civil, structural, architectural, electrical and C&I works including chutes, monorails, hoists/chain pulley blocks, hoist maintenance platforms, external staircases, dust debris chutes etc. All over-ground junction towers shall have separate debris disposal chute up to the ground floor. Underground junction towers shall be provided with machinery hatches along with monorail, electric hoist for handling equipment from underground to over ground. |
| 2.01.09 | Complete chute work along with chute block switches and actuator operated flap gates, mobile discharge pulleys (as applicable) in all junction towers between various conveyors. |
| 2.01.10 | Suitable number of motorized travelling tripper / flow diverter plough (as applicable) on each feeding conveyor for feeding the crushed limestone to the covered storage shed. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structure (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc. |
| 2.01.11 | One number of covered storage shed for crushed limestone. The storage shed shall be sufficient to store limestone equivalent to consumption of minimum 7 days at Design Point (Generation of all units to be considered). A reclaim hopper shall be provided below the limestone storage shed for the entire length of the stockpile. Alternatively, suitable number of Limestone Storage Silos to store limestone equivalent to consumption of minimum 7 days. Suitable number of Belt feeders below silos shall be provided taking feed from silo and discharging onto onward conveyors/ Bucket elevators. |

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| 2.01.12 | Two (2) numbers paddle feeders (in case of covered storage shed) complete with all electrical, rails, supporting structures, end stops, cable reeling drums, trailing cables, and necessary arrangement for cabling on floor of reclaim hoppers along with accessories, shall be installed at the bottom of the reclaim hoppers to scoop the limestone from reclaim hoppers and feed limestone on to the underground conveyors. |
| 2.01.13 | Two (2) nos. of lime sampling units, one for as received limestone in crusher house and one for as used limestone in TP before feeding to limestone bunkers, complete with all accessories and electrical, civil, structural works, supporting structures, approach/maintenance platforms, hoists etc. |
| 2.01.14 | Suitable number of ploughs and its actuating mechanism shall be mounted on each conveyor to feed limestone into limestone mill bunkers. Alternatively, suitable nos. fixed Trippers on each conveyor to feed limestone into limestone mill bunkers. |
| 2.01.15 | Minimum four (4) Nos. sump pumps in limestone storage shed (in case of covered storage shed), and two (2) Nos. sump pumps in all TPs completely or partially underground complete with motors, local control panel, level switches, individual discharge piping with fittings and valves to nearest plant drain including pipes etc. upto disposal point. |
| 2.01.16 | Adequate number of ventilation equipment for ventilating the limestone reclaim hopper, underground tunnel of Conveyors, underground portion of Junction towers and limestone bunker bays (housing tripper/plough conveyors) complete with all mechanical, electrical, civil and structural works and associated foundations. |
| 2.01.17 | Pressurized Ventilation system for all Switchgear rooms, MCC rooms complete with all mechanical, electrical, accessories, civil and structural works. |
| 2.01.18 | Exhaust fans to be provided in all battery rooms and all toilets complete with electrical, civil & structural works etc. Supply and exhaust fans along with required ducting shall also be provided for all underground Structures/junction towers complete with all mechanical, electrical, civil and structural works and associated foundations. |
| 2.01.19 | One (1) number of passenger cum goods elevator with drives, all electrical, mechanical, civil, structural & associated foundation works, accessories and electrical to serve various floors of lime stone crusher house. |
| 2.01.20 | Two (2) numbers of in line magnetic separators (one no. on each conveyor feeding to crusher house) and two (2) number of suspended magnets, (one no. on each conveyor feeding to Limestone bunker (in case of covered storage shed)) on conveyors complete with reject chutes, reject trolleys, supporting arrangement and all mechanical, electrical, civil, structural works and accessories. |
| 2.01.21 | Four (4) numbers of metal detectors (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant) complete with all mechanical, electrical, civil, structural works and accessories. |
| 2.01.22 | Four (4) numbers of electronic type belt scales (min. one no. on each conveyor feeding to crusher house and conveyor feeding to Limestone bunker at FGD plant) for continuous weighing, complete with all mechanical, electrical, civil, structural works and accessories. |

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| 2.01.23 | Complete dust extraction system for control of fugitive dust in limestone storage shed / Silos, junction towers, crusher house complete with fans, drives, hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works. |
| 2.01.24 | Service water and potable water system for complete limestone handling plant. Water Pump houses & water tanks for service water, cooling water (as applicable) and potable water system. |
| 2.01.25 | Cooling water system (as applicable) for scoop couplings, for complete limestone handling plant. Air cooled type scoop couplings are also acceptable. |
| 2.01.26 | Monorails and electrically operated hoist blocks as well as hand operated chain pulley blocks for servicing/installation/easy replacement of drive machinery, different types of pulleys for all conveyors, GTU and other equipment from ground level to their locations and vice-versa & landing inside the respective Buildings. |
| 2.01.27 | One (1) number of belt vulcanizing machine, suitable for all belt widths in limestone handling system, complete with all mechanical, electrical, accessories and consumables for one year of consumption. Further belt jointing facilities as specified shall be provided. |
| 2.01.28 | Minimum one (1) no. Weighing Bridge for Road trucks / Tipplers shall be provided each in Limestone unloading area and in Gypsum Loading area. |
| 2.01.29 | All buildings shall be complete with all electrical, civil, structural, architectural works, cable trenches, fire safety walls, foundation, earth mat, fencing, earthing for transformers. All cables, duct banks, trenches, cable trestles shall be complete with associated civil/ structural work and necessary civil foundations. |
| 2.01.30 | Drainage of LHP buildings, tunnels, conveyor galleries and limestone storage shed / Silos including all civil & structural works as detailed out elsewhere in the specification. |
| 2.01.31 | All equipment/fittings, supporting structure, along with insert plates, bolts, accessories, MS sleeves, base plates, grouting as may be required and proper alignment etc. |
| 2.01.32 | Complete un-used set of all special tools and tackles, which are necessary or convenient for erection, commissioning and overhauling of any equipment, covered under the scope. |
| 2.01.33 | First fill of all consumables, e.g.; oils and lubricants for one year toppings requirements. |
| 2.01.34 | Preservative shop coating, final painting of all structures and equipment. |
| 2.01.35 | All inserts, anchor bolts, foundation bolts for Contractor's equipment, platforms etc. in the entire LHP. |
| 2.01.36 | All necessary grouting & finishing of the floor after welding at all such pockets & elsewhere is in Contractor's scope. |

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| **3.00.00** | **GYPSUM HANDLING PLANT (GHP)** |
| 3.01.00 | Gypsum shall be conveyed from the vacuum belt filter to the storage shed through a series of double stream conveyors and transfer points/junction towers. |
| 3.02.00 | One number of covered storage shed for gypsum. The storage shed shall be sufficient to store gypsum equivalent to gypsum generation of minimum 7 days at Design Point (Generation of all units to be considered). |
| 3.03.00 | Minimum four (2) Nos. sump pumps in gypsum storage shed complete with motors, local control panel, level switches, individual discharge piping with fittings and valves to nearest plant drain including pipes etc. up to disposal point. |
| 3.04.00 | Complete dust suppression system for control of fugitive dust in gypsum storage shed, complete with pumps, water tanks, drives, hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works. |
| 3.05.00 | Service water and potable water system for complete gypsum handling plant. Water Pump houses & water tanks for service water, cooling water and potable water system. Common pump house for Limestone handling plant gypsum handling plant is also acceptable. |
| 3.06.00 | Suitable number of motorized travelling tripper / Flow diverter (as applicable) on each feeding conveyor for feeding the gypsum to the covered storage shed. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structure (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc. |
| 3.07.00 | Gypsum from storage shed shall be loaded to user's trucks using front end loader/ pay loader. |
| 3.08.00 | Complete ventilation system for gypsum storage shed. |
| 4.00.00 | Bidder to note that the above list is not exhaustive and any work required for integration of complete system and ensuring its satisfactory running shall be in the scope of work and supply for this package. |

# SUB-SECTION-III- A**6**

# ZERO LIQUID DISCHARGE SYSTEM

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## FGD WASTE WATER TREATMENT (FGD WWT) SYSTEM FOR ZLD

**1.00.00 General**

1.00.01 A FGD Waste Water Treatment (FGD WWT) System for Zero Liquid Discharge (ZLD) shall be provided by the Contractor for storing, treating and re-using all wastewaters generated from Wet Limestone based FGD system for Barh STPP St.-I (3x660MW) and Nabinagar TPP (4x250 MW) Units. The contractor shall provide evaporative concentration process for FGD Wastewater Treatment Plant to achieve zero liquid discharge (ZLD). The treatment system shall be comprised of the systems like wastewater storage, suspended solid removal, Pre-treatment (including decalcification process), Evaporative concentration, Treated water disposal, Chemical feed, Sludge dewatering etc. The removed impurities from the FGD Waste Water Treatment (FGD WWT) plant will be bound in the form of solid cake, hence allowing the station to be complete ZLD.

1.00.02 The scope of work for the equipment and accessories to be furnished in accordance with this specification shall include design, manufacture, engineering, inspection and testing at Contractor's work(s), packing, forwarding to site, unloading, erection, supervision, pre-commissioning, testing, commissioning and performance testing of the equipment/systems indicated hereunder. Items though not specifically mentioned in the specification but needed to complete the equipment and systems to meet the intent of specification, shall also be deemed to be included unless otherwise specifically mentioned under exclusions.

1.01.00 **Wastewater storage, Suspended solid removal process, Pre-treatment system**

Pre-treatment system shall consist of FGD waste water storage tank (2x50%) to store FGD wastewater, GGH washing water etc., Aeration devices, lime, ferric chloride and soda ash unloading, storage, dosing & reaction system for pH adjustment, reaction and coagulation, Clarifier feed pumps, Primary Clarifier (1x100%), Secondary Clarifier (1x100%), Clarified water/Evaporator/Brine Concentrator (BC) feed tank, Evaporator/BC feed pumps, Sludge sumps, Filter press feed pumps, Filter press (2x50%), Filterate water tank, Filterate water transfer pumps, piping, valves, instrumentation etc. to make the system complete.

1.02.00 **Evaporative concentration system**

The softened wastewater shall flow to the evaporation phase of the plant. Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system. The Evaporative Concentration system shall be comprised of Evaporator feed tank(s), feed pumps, Evaporator feed Heat exchanger(s), Deaerator(s), Mechanical Vapour Compressor(s), Evaporator(s), Evaporator Recirculation pumps, Distillate tank(s), Distillate Pumps, Vacuum pumps (If applicable), Seeding system, Chemical feeding system, vapour ducts, recirculation ducts, piping, valves, instruments etc. shall be provided as required as per system chemistry to make the system complete.

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The Crystallizer (1x100%) system shall be equipped with Crystalliser feed tank, feed pump, Crystalliser Heater, Crystalliser Condenser, Crystalliser distillate pump, Crystalliser Vapour body, Crystalliser Recirculation pump, Crystalliser Condensate tank, Crystalliser Condensate Pumps, Centrifuge feed pump, Centrifuge (2x50%), Centrate tank, Centrate Pump, Anti foaming system, chemical feed system, vapour ducts, recirculation ducts etc. as required as per system chemistry to make the system complete.

Hoist(s) for various vessels in evaporative concentration system, pressure transmitters, level transmitters with root valves, drain pipes equipped with float traps, Y-strainers, bypass valves, shut-off valves etc. shall be provided as per system requirement.

1.03.00 **Chemical storage, dosing system**

Chemical storage and injection equipment comprising of all required chemical feed equipment like chemical storage tanks, chemical dissolving tanks, chemical injection tanks & pumps, agitators, heaters, fume scrubbers etc., necessary chemical unloading/transfer pumps, auto dissolving equipment (if polymer is used), level gauge for all chemical tanks etc., electric heater for caustic tank, electric heat tracing for caustic piping, chemical feed pumps, chemical dosing/injection pumps, all other necessary equipment and accessories etc. as specified and as per system requirement shall be provided to make the system complete.

1.04.00 **Other**

a) Exterior & interior equipment support foundation and foundation accessories such as sole plates, counter flanges with bolts, nuts, gaskets, packing, channel base, sub-sole plates, shims, wedges, foundation anchor bolts and nuts, anchor frame and nuts, grout, embedded materials, etc.

b) Piping and valves including safety and relief valves, hangers and supports etc.

c) All required insulation and lagging materials supply and installation.

d) Lifting devices such as crane, hoist, trolley and monorail, etc.

e) Set of connections, flow element flanges and all other items, required for performance test.

f) Complete lubricating oil system and cooling water system, wherever required.

g) All instruments, instrument nozzles, connections, root valves, sensing lines and their installation materials complete with instrumentation to measure and indicate all fluid conditions.

h) Consumable materials and/or erection spare parts which will be required for storage, installation, start-up, to put the equipments covered under the scope of specifications, into successful commissioning/initial operation and to establish completion of facilities shall be provided by the bidder, unless specifically excluded under the exclusions in the specifications and documents.

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i) All the first fill & one year's topping requirement of consumable such as chemicals**,** greases, oil, lubricants, servo fluids etc. which will be required to put the equipments covered under the scope of specifications of Zero liquid discharge (ZLD) Plant for FGD waste water, into successful commissioning/initial operation and to establish completion of facilities shall be provided by the bidder, unless specifically excluded under the Exclusions in these specifications and documents. Suitable standard lubricants as available in India are desired. Effort should be made to limit the variety of lubricants to minimum.

j) All attemperator systems including piping, control valves, isolation valves, check valves and bypass valves.

k) Enclosures for required systems. These include sound, personnel protection, weather and any other enclosures necessary to ensure a complete operating system.

l) Grounding pads with clamps or studs on the equipment.

m) Stairs and ladders, walkways, handrails, platforms and supports for monitoring, operation and maintenance of all equipment furnished by the Supplier.

n) Safety showers and eye washers

o) Sample connections

p) All required modification, replacement, relocation, demolition work of existing facilities.

q) Vinyl esteric resin mortar material for tank lining.

r) All interconnecting piping, piping supports, valves and instrumentation.

s) All support platforms and access (by stairs) shall be provided. This applies to both indoor and outdoor piping/equipment. Ladders shall be used for secondary access only.

t) Stairs shall be able to access all platforms. All exterior steel shall be epoxy black powder coated, no galvanized steel permitted in exterior applications.

u) The contractor shall envisage and provide any additional system as required to meet to make the system complete.

# SUB-SECTION-III-B

# ELECTRICAL SYSTEM/EQUIPMENT

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## ELECTRICAL SYSTEM / EQUIPMENT

1.00.00 **GENERAL**

The Contractor's scope shall include design, engineering, manufacture, type testing, inspection & shop testing at supplier's works, packing, forwarding to site including customs clearance/ port clearance (if required), receipt and unloading, in plant transportation, handling and storage (preservation & conservation of equipment) at site, erection including associated civil and structural works, testing and commissioning of the Electrical equipment/ system and works indicated in this chapter. The scope includes all interface/ interconnections with the electrical systems under this contract as required and other systems mentioned elsewhere. Unless explicitly stated to be common for all the units, the Contractor shall provide all system/equipment for each of the units. The Electrical scope shall be as described briefly in the following clauses but not limited to it.

1.01.00 **MOTORS**

Motors along with couplings and coupling guards for all rotating auxiliaries covered under this package.

1.02.00 **HT/ LT SWITCH GEAR**

HT and 415V Switchgear / Motor control centers (as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001) Busduct / Cable (as applicable), distribution boards, AC/DC fuse boards, LDB, local emergency push button stations for all drives energized from MCC's under contractor scope and local motor starters (for ventilation fans) as required for plant and equipment in contractor's scope.

1.03.00 **DC SYSTEM**

**Battery and Battery Charger**

Lead acid plante type/ Nickel Cadmium batteries and Float cum boost chargers for plant and equipment in the scope of the contractor, as per system requirement. The DC system (Battery and Charger) shall be supplied to cater to various DC loads in the plant. The design and sizing criteria shall be as detailed out in the chapter B-0, Part-B of Technical specifications.

1.04.00 **TRANSFORMERS**

Transformers as per Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 and system requirement, however bidder to provide complete sizing & selection criteria of Transformer's feeding Contractor's own systems.

1.05.00 **ELECTRIC ACTUATORS**

Electric actuators with integral starters along with associated accessories etc shall be supplied on as required basis for Valves / Dampers to meet the functional and the other specification requirements.

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| 1.06.00 | **CABLES / BUSDUCT**<br><br>All HT/ LT power & control cables required for connection between equipment/devices in contractors scope and cables / Busduct (as applicable) between employers and contractors equipment as per Electrical Single Line Diagram Drg No. 0011-109-POE-J-001). |
| 1.07.00 | **DG SET (IF APPLICABLE)**<br><br>Diesel Generator sets of stationary type comprising the following:<br><br>(1.) Diesel Engine Complete with all accessories<br><br>(2.) An alternator directly coupled to engine through flexible/rigid coupling complete with all accessories (CT's & VT's etc.)<br><br>(3.) Control Panel<br><br>(4.) Complete starting arrangement along with battery ,its charger<br><br>(5.) Base frame and foundation bolts etc.<br><br>(6.) Exhaust ducting meeting the statuary requirements, accessories, support structure and foundation bolts.<br><br>(7.) Day Oil Tank, fuel piping and accessories<br><br>(8.) Interconnection piping and accessories<br><br>(9.) Power and control cable gland and lugs at Bidder's equipment for all cables<br><br>(10.) Cable & Cabling between Bidder's equipment.<br><br>(11.) All lubricants for first filling, consumables and touch up paints etc for commissioning.<br><br>(12.) Acoustic enclosure meeting the statuary requirements. Necessary ventilation along with necessary starters & lighting shall be provided. |
| 1.08.00 | **CABLING**<br><br>1) Contractor shall provide cable trays and their accessories with support arrangements, trestle, trenches, duct bank etc. as required for the cables under his scope of supply for the complete system. However the Cable tray, supports and tray earthing for contractor cables on employer cable vault shall be supplied by employer.<br><br>2) Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 on the employers nearest trestle in the FGD area as shown in Drg no 0011-999-POC-F-001 subject to availability of space and suitability. In case of non availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection & cable laying. Further Contractor shall |

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| | supply cables, trestle, trenches, duct bank, cable slit, cable trays and structure etc. from employer trestle to the equipment in FGD area in the contractor's scope.<br><br>3) Contractor shall supply, lay and terminate the cables under his scope of supply<br><br>4) The contractor shall furnish the complete and consolidated feeder list for DC system, LT system and HT system for all loads and drives under the scope of supply of contractor to employer as per the format enclosed at Annexure-A. Contractor shall indicate the location of his equipment's in feeder load list.<br><br>5) Contractor shall provide cable glands and lugs for all equipment's in his scope.<br><br>6) Contractor shall provide all accessories such as rigid/ flexible conduits, fittings, junction boxes, tying materials, cable tags, and markers etc. for the cables under his scope.<br><br>7) Contractor shall provide Straight-through jointing kits for HT XLPE power cable, LT power and control cables, Cable termination kits for HT XLPE power cables, Welding receptacles, Trefoil cable clamps, Junction boxes.<br><br>8) Contractor shall provide Galvanised steel pipes/HDPE/hume pipes/PVC pipes, Miscellaneous items like M.S sections etc as required,<br><br>9) Contractor shall provide Fire proof cable penetration sealing system of Type-A and Type-B for cable galleries, cable exits etc<br><br>10) In addition to other drawings, Contractor shall also prepare complete equipment layout drawings, lighting layout drawings including cable tray layout, routing, Power and control cable schedules etc<br><br>11) Control interconnection charts shall also be prepared by bidder |
| 1.09.00 | **LIGHTING**<br><br>Complete lighting system for internal and external areas for the plant, buildings, chimney and equipment in the bidder's scope. Lighting fixtures complete with lamps & accessories, LED lighting fixture complete with driver circuit & accessories Lighting Panels, Chimney aviation light, Receptacles, Switch boxes. Conduits. Lighting Wires, Ceiling fans with regulators, Lighting poles. Lighting masts, Earth wires and rods, Junction boxes, Battery operated automatic self contained lighting fixture, Maintenance ladders as required are included in the bidder's scope.<br><br>Mandatory spare parts and maintenance equipment as required. |

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1.10.00 **EARTHING AND LIGHTNING PROTECTION**

Complete below ground earth mat and above ground equipment earthing system and lightning protection for the plant and equipment under contractors scope along with its interconnection to the nearest employers earth grid at two points.

1.11.00 **PAINTING FOR ELECTRICAL EQUIPMENT**

The painting of all electrical equipment shall be epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. The Contractor shall furnish the complete painting details during detailed engineering stage.

1.12.00 **CONSTRUCTION POWER**

To meet the construction power requirement of the FGD and associated systems, the Employer shall provide Two Number 415V feeders in LT switchgears. The Contractor shall extend supply from these Construction power feeders to meet the construction power requirements at the various locations included in the Contractor's scope through suitably rated Isolation Transformers along with LT distribution boards as per requirement. LT Packaged Sub-stations with isolation transformers may also be used for this purpose. Suitable metering arrangement along with associated Instrument transformers and Metering Cubicles meeting the DISCOM requirements shall be provided by the Contractor at each Construction power feeder, for the measurement of actual energy consumed by the Contractor. The charges only for the actual energy consumed by the Contractor shall be recovered by the Employer based on prevalent rate of DISCOM.

Supply, erection, testing and commissioning of all equipments as required for further distribution for meeting the construction power requirements shall be in the Contractor's scope. All necessary statutory requirements for charging construction power of Contractor's network shall be in the Contractor's scope. Construction power supply network is a temporary arrangement which shall be used during the project construction phase. To meet this requirement, the equipments may be arranged by Contractor either by shifting their existing equipments at other installation or by fresh procurement, which may be taken back after commissioning of the project.

Even though the Employer shall make all efforts to maintain a continuous supply of construction power, the same is not guaranteed and Employer shall not be responsible for any loss or delays which the contractor may suffer on this account. Also the Employer shall not entertain any claim for exemption/reduction of liquidated damages for delay in execution of the contract due to irregular power supply. Contractor shall arrange/provide necessary backup arrangement on his own for uninterrupted power supply.

The Contractor shall maintain a minimum drawl power factor as per DISCOM regulations for their substations, and all such devices for maintaining power factor

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shall be under the scope of contractor. All temporary wiring must comply with local regulations and will be subject to Employer's inspection and approval before connection to supply. Power supply shall not be provided for use in labor and staff colony.

1.13.00 **TYPE TEST**

Contractor shall carry out all type tests on electrical equipment's as stipulated in relevant chapters of Part-B of technical specifications.

1.14.00 **MANDATORY SPARES**

Contractors scope shall include Mandatory Spares of all equipment as mentioned in the relevant portion of Technical Specification.

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Annexure-A

STANDARD FORMAT FOR ELECTRICALFEEDER LOAD LIST

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S. No. | KKS code as in vendor drawing | Description of feeder | Rating (KW/A) | Supply type | Unitised /Station | Normal / Emergency | Feeder type | Running Mode | Recommended cable size | Location Coordinates | Remarks |
| | | | | | | | | | | | |
| GUIDE LINES TO FILL THE FORMAT | | | | | | | | | | | |
| Column No. | Legend | Designation | Description | | | | | | | | |
| 1 | S. No. | 1,2,3 | Serial Number | | | | | | | | |
| 2 | KKS code as in vendor drawing | - - - | Unique kks of the Equipment | | | | | | | | |
| 3 | Description | - - - | Description of the bidders Equipment | | | | | | | | |
| 4 | Rating | | Name plate Rating in kW or Amps at 50 deg C | | | | | | | | |
| 5 | Supply type | 11 KV 3 ph AC / 3.3 KV 3 Ph AC / 415 V 3 Ph AC / 220 V DC / 240 V AC UPS / 240 V AC Non -UPS | | | | | | | | | |
| 6 | Unitised/Station | U | Unit(U) is applied for each unit. | | | | | | | | |
| | | S | STN(S) is applied for common equipment load. | | | | | | | | |
| 7 | Normal / Emergency | N | Normal Supply | | | | | | | | |
| | | E | Emergency Supply(Emergency supply i.e DG supply) | | | | | | | | |
| 8 | Feeder type | U | Unidirectional Motor feeder | | | | | | | | |
| | | B | Bidirectional Motor feeder | | | | | | | | |
| | | H | Heater feeder | | | | | | | | |
| | | S | SFU(switch fuse feeder) | | | | | | | | |
| 9 | Running Mode | W | Working | | | | | | | | |
| | | S | Standby | | | | | | | | |
| 10 | Recommended cable size | - /- / - /- /- | Recommended Incoming power cable size in: No of runs/no. of cores/ Size in mm2/Al or Cu/ PVC or XLPE | | | | | | | | |
| 11 | Location | | Location of the Equipment in coordinates row & columns as per layout | | | | | | | | |
| 12 | Remarks | | Any other relevant information | | | | | | | | |
| Notes: | 1) Electrical Load list shall be submitted as "MS Excel" sheet also in addition to that in pdf as per the format given above. | | | | | | | | | | |
| | 2) Each Row shall contain data of Only One equipment / load. i.e., if there are two numbers of the same equipment, they shall be indicated in two different rows with unique description & tag number. | | | | | | | | | | |

# SUB-SECTION-III-C

# CONTROL AND INSTRUMENTATION SYSTEM

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**CONTROL AND INSTRUMENTATION SYSTEM**

**1.00.00 GENERAL**

a) The Contractor shall provide Independent Control & Instrumentation system for control, monitoring and operation of associated drives and auxiliaries in FGD system including Limestone grinding & handling system, Gypsum Dewatering & handling system, Zero liquid discharge system (ZLD) (if provided) and other systems being provided under the contract, in all regimes of operation in safe and most efficient manner. The Contractor shall provide all systems, equipment, accessories and associated equipment, which are included in Contractor's scope, in a fully operational condition acceptable to the Employer.

b) The Contractor shall provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. The work shall be consistent with modern FGD based power plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract.

c) The Contractor shall also provide all the instruments along with cables, JB etc. for equipments / drives and services which may not be specifically stated in this specifications but are required for completeness of the FGD Control system shall be furnished by the Contractor and for meeting the intent and requirements of these specifications.

d) The Bidder scope shall include design, manufacture, engineering, inspection & testing at supplier's works, packing, forwarding to site, unloading, erection, testing & commissioning. The following clauses describe the brief scope of supplies. Scope shall be as described briefly in the following clauses but not limited to it. The detailed technical specifications are stipulated under Part - B, Section-VI of the specification as well as in various other Parts of the Technical Specifications.

**2.00.00 MEASURING INSTRUMENTS**

The following shall be provided as a minimum, meeting specification requirements of Sub-section - MEAS INST of Part-B, Section-VI of Technical Specification.

2.01.00 Primary instruments like Microprocessor based transmitters employing HART protocol, thermocouples & RTDs along with temperature transmitters, pressure/diff. pressure/temperature/flow (Ultrasonic/electromagnetic) transmitter & gauges, flow sensing elements (orifice plates, flow nozzles etc), Ultrasonic, Radar type level transmitters, density meter (Coriolis type. In case the bidder proposes other type of density meter as per the bidder standard and proven practice, the same shall also be acceptable except Nucleonic

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type density meter), pH analyser, SO2 analyser, Flue Gas flow transmitter, vibration transmitter, Analyzer for ZLD system etc. for:

(a) FGD plant and other system being provided under the contract, as indicated in enclosed tender diagrams (Part E) of this specification.

(b) Integral to equipment which are not indicated in the tender drawings, but are required for control, monitoring and operation of the equipment / plant systems for which no P&IDs are enclosed, all the instruments shall be provided to meet the actual system requirements and meeting redundancy and other requirements specified under technical specifications subject to Employer's approval.

(c) For Binary and analog inputs required in major equipments of FGD system, protection triple-sensing devices shall be provided. Binary and analog inputs, which are, required for protection of more than one equipment as well as protection signals for HT Drives etc., triple sensing devices shall be provided. However, for vibration measurements and protection minimum 2 number (X and Y direction) sensors per bearing shall be provided.

(d) For other critical binary and analog inputs required for protection and interlock purpose of other equipment (e.g. those interlocks which may result in loss of production, non-availability of a major equipment etc.), triple sensors shall be provided.

(e) Temperature elements, electronic transmitters etc. are to be provided for all the cases. Use of process actuated switches is acceptable only in the cases as indicated in the tender drawings.

2.02.00 Single Input DIN rail mounting type temp transmitters (mounted in JBs) shall be provided by the Contractor for all temperature elements under Contractor's scope.

**2.03.00 CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)**

2.03.01 CEMS comprising of analysers and associated items for measurement of SOx, NOx, CO, CO2, Mercury, Particulate Emission (dust density/ stack opacity) monitor, Stack Flue Gas Ultrasonic Flow Meter shall be provided for each unit by the Contractor for stack emission monitoring.

**A) LIST OF FLUE GAS EMISSION ANALYSERS**

| S. No. | KKS CODE | DESCRIPTION | RANGE | ZONE | REMARK |
|---|---|---|---|---|---|
| 1 | HNE10CQ005 | SOx ANALYSER | 0-300/0-1000PPM (SELECTABLE) | CHIMNEY | |

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|---|---|---|---|---|---|---|
| | 2 | HNE10CQ001 | NOx ANALYSER AT CHIMNEY | 0-300/0-1000PPM (SELECTABLE) | CHIMNEY | |
| | 3 | HNE10CQ002 | CO2 ANALYSER | 0-40% | CHIMNEY | |
| | 4 | HNE10CQ004 | CO ANALYSER | 0-1000 (SELECTABLE IN 0-100/0-200,0-500,0-999 PPM) | CHIMNEY | |
| | 5 | HNE10CQ003 | OPACITY ANALYSER AT CHIMNEY | 0-999 mg/m3 (PROGRAMMABLE) | CHIMNEY | |
| | 6 | HNE10CQ006 | Mercury (Hg) Analyser | 0-100 microgram/Nm3 | CHIMNEY | |
| | 7 | HNE10CQ007 | Flowmeter (Ultrasonic Time of Transit Type | - | CHIMNEY | |

Notes:- 1) SOx, NOx, CO2 and CO analyser are shown separately for the purpose of input only, otherwise SOX, NOX, CO2 and CO analyser may be supplied as a single unit/ Combined Unit (s) meeting specification requirement.

2) These are per unit quantities.

2.03.02 CEMS, instruments shall be provided with provision for bidirectional connectivity over Modbus/RS-232/RS-485 with Employer's central cloud server for real time data monitoring, remote diagnostics & remote calibration checks, etc., complying with CPCB IT Division document "Protocol for real time (Emission & Effluent) data management from industries version 1.2 (10.6.2015) or the latest regulatory requirement prevailing at the time of award of the contract. All necessary hardware and software required at instrument end shall be provided by the Contractor. Necessary details like scheme, register addresses of analyzer, etc. shall also be provided by the Contractor for implementation of above. The Contractor shall fully assist NTPC's agency involved in implementation of above connectivity.

For CEMS - In addition to above requirement, 4-20 mA connectivity to DDCMIS shall be provided by the Contractor

2.03.03 Comprehensive Annual Maintenance Contract (AMC) for three (03) years after warranty period shall be provided by the contractor for CEMS.

2.04.00 SERVICES DURING DEFECT LIABILITY PERIOD FOR CEMS

2.04.01 The Contractor shall provide an unlimited warranty on all equipments during the Defect liability period. This warranty shall include repair, replacement, replenishment of consumables (for e.g. reagents, calibration gases etc. as applicable) and correction of identified discrepancies including Analysers, Sample Handling System, Transmitters, (as applicable) etc. at no cost to Employer.

2.04.02 The Contractor shall provide warranty spares including components for each system based on (and keeping adequate over margin) normally experienced failure rate. Exhaustive list of

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| | all such items shall be submitted along with Datasheet for Employer's review and approval during details Engg stage regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the Contractor along with the main equipment consignment. However for items which have a limited shelf life shall be dispatched in a phased manner during the warranty period. Unused spares/consumables shall be Contractor's property after expiry of warranty period and shall be taken back. |
| 2.05.00 | SERVICES DURING ANNUAL MAINTENANCE CONTRACT (AMC) PERIOD FOR CEMS |
| 2.05.01 | The Contractor shall provide complete maintenance services for each System under comprehensive Annual Maintenance Contract (AMC) for period of three years after the Warranty period. |
| 2.05.02 | The AMC shall cover total maintenance of all Analysers, Sample Handling System ,Transmitters etc. coming under the scope of each system and shall include free repair/replacement of each items, replenishment of consumables, correction of problems (if any) and supply of expendable items. |
| 2.05.03 | Further, Contractor may note that during the AMC he will be allowed to use Employer's mandatory spares, but has to replenish the same within three months' time or before completion of AMC period whichever is earlier. |
| 2.05.04 | The Contractor shall prepare detailed list of faults corrected and parts, expendables utilized during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Contractor's personnel. |
| 2.05.05 | Contractor shall also provide a list of all required AMC spares which shall be finalized along with datasheet during detail Engineering stage. These spares will be dispatched by the Contractor at the beginning of AMC on yearly requirement basis. However for items which have a limited shelf life shall be dispatched in a phased manner during the AMC period. Unused spare/consumable shall be Contractor's property after expiry of AMC period and shall be taken back. |
| 2.06.00 | DEPUTATION OF ENGINEER/ TECHNICAL EXPERT FOR CEMS |
| 2.06.01 | Contractor shall depute Technical Experts of the OAM /OEM/OES/ (Original Analyser Manufacturer/Original Equipment Manufacturer/Original Equipment supplier) for each of the above system at Site, who will be fully qualified to perform the required duties, supervision of maintenance, repair etc. for a period of six month. Employer will intimate the contractor two weeks advance notice for start of deputation period. |
| 2.06.02 | After expiry of above six month period, Technical expert for each system shall visit site on monthly basis for monitoring the performance and rectify the problem (if any) for each system for the remaining warranty period and during entire AMC period. In the event of any malfunction/fault/failure in the system or any component thereof contractor shall depute Technical expert of respective system to reach site within 48hrs of call raised by site during the remaining warranty period and entire AMC period. |

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**3.00.00** **PROCESS CONNECTION & PIPING**

Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated under Sub-section PCP, Part-B, Section-VI of Technical Specification.

**4.00.00** **INSTRUMENTATION CABLES, C & I SYSTEM, POWER SUPPLY DISTRIBUTION CABLES & CABLE SUB-TRAYS**

a) All instrumentation cables (twisted & shielded, FRLS PVC insulated and sheathed), data highway / fibre optical cables including prefabricated cables (with plug-in connectors), cables as applicable for direct interconnection of two equipment/ system/ devices in Contractor's scope as well as for connection of signals from/to systems like MCC/LT SWGR/HT SWGR etc. (even if they are not in Contractor's Scope.) shall be provided by Contractor on as required basis.

b) All power supply distribution cables required for directly connecting two equipment / systems devices in contractor's scope shall be provided by the contractor. All these cables shall be FRLS & as per IS-1554 Part – I latest edition.

c) Above cables shall be provided along with necessary laying & termination accessories, hardware etc. meeting requirements specified under Sub-section INST CABLE, Part -B, Section-VI of Technical Specification. All sub trays along with supporting, connecting hardware etc. required for laying of instrumentation, control, power and other cables etc. up to main cable trays are under Bidders scope.

d) Cables required for interfacing PLC control system with Employers DDCMIS (both SG and BOP) located in CER shall be in bidder's scope.

e) Cables for connectivity of CEMS signals to Employer's Unit DDCMIS located in unit CER shall be in bidder's scope.

f) Junction boxes and power distribution boards for C&I Systems with requisite terminals shall be provided on as required basis.

**5.00.00** **CONTROL VALVES & ACTUATORS**

5.01.00 Control valves, actuators and accessories, shall be provided on as required basis for meeting requirements specified under Sub-section CONTROL VALVE, Part-B, Section-VI of Technical Specification. Specially designed valves/trims to prevent cavitations and limit noise and control outlet velocity, shall be provided.

5.02.00 Microprocessor Based Electronic Positioner is to be provided on as required basis with all the Control valves and all control dampers being provided by the contractor.

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| **6.00.00** | **CONTROL SYSTEM** |
| 6.01.00 | Instrumentation and Control System with interlocks, protection and annunciation for FGD system and other system being provided under the contract shall be provided with Software and hardware as required to provide a complete functioning of the system. Dual processor based PLC system with PC based Operator Work Station (OWS), programmable station and A4 size color Laser printer etc. on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). The PLC configuration drawing shall be as per Tender drawing no. 0000-151-POI-A-013. Depending on the cable distance between FGD control room and FGD system such as Gypsum handling system, Limestone handling system etc, requirement of Remote Input Output (RIO) shall be finalized during detail engineering, In such cases, contractor to provide RIO on as required basis. |
| 6.02.00 | The Bidder shall provide software license for all software being used in Bidder's System. The software licenses shall be provided for the organization i.e. it should not be site-specific and shall also not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Owner to seek a new license/renew license due to up gradation/change of hardware/machine in Bidder's System at site. All licenses shall be valid for the continuous service life of the plant. |
| 6.03.00 | For each equipment/drives/pumps where Local Operation is envisaged in addition to control system as mentioned in respective Mechanical Sections, Bidder to consider Local Push button station comprising following:<br><br>a) Start Push Button<br>b) Stop Push Button<br>c) ON Running Lamp<br>d) OFF Lamp<br>e) MCC Disturbance Indicating Lamp |
| 6.04.00 | Contractor has to provide KKS codes for instrument and drives in the P&ID and other related document. |
| 6.05.00 | The minimum quantity per unit of furniture envisaged in FGD control room is as mentioned below:<br><br>a) Chair-4 nos.<br><br>b) Printer table- 1 no<br><br>c) Computer table- 2 no.<br><br>d) Key pad- 1 no.<br><br>e) Locker set -1 no |

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| 6.06.00 | Complete wiring / cabling from field devices to panels / MCC and vice versa including conduits / trays / fixtures etc. shall be in bidders scope. |
| 6.07.00 | Microprocessor based modular 24V DC power supply system shall be used for powering the control systems including its network devices.<br><br>24V DC power supply system for PLC based control system shall comprise of two sets, each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller – one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.<br><br>Contractor shall provide UPS of suitable capacity for the intended application meeting the requirements of Technical Specifications as per Cl. No. 9.05.00, Part B, III-C5.<br><br>Contractor to note that UPS of configuration C is acceptable only upto 5 KVA. In case the consolidated load requirements exceeds 5 KVA, Contractor to provide UPS with Configuration B in place of Configuration C as per Technical Specifications as per Cl. No 9.05.00, Part B, III-C5.<br><br>Bidder shall provide power supply distribution panels/cabinets/boxes for sub distribution of DC/Main UPS/Utility feeders on as required basis. The power supply distribution box shall include change over circuitry, switch fuse units, MCBs, terminal blocks etc. suitable for application.<br><br>For detailed requirements of FGD system, refer Sub-Section III-C, Part B Section VI of technical specifications. |
| **7.00.00** | **TYPE TEST REQUIREMENT**<br><br>The type tests to be conducted for C&I systems & equipments shall be as detailed out in Sub-Section-C-06 Type Test Requirements, Part-B, Section-VI of Technical Specification. |
| **8.00.00** | **TOOLS & TACKLES**<br><br>The Contractor shall furnish a complete new set of all special tools and tackles of reputed make and model which are required for erection, ease in maintenance to have minimum down time, testing and calibration of all the equipments and systems to be provided by the Contractor under this specification for C&I systems. |
| **9.00.00** | **Interfacing with Employer's DDCMIS** |
| 9.01.00 | Hardwired Signal exchange: Hardwired signal exchange between BOP DDCMIS (under Employer's scope) and FGD PLC (under Contractor's scope) like bypass damper status, inlet and outlet gates status, ID Fans status, ESPs status, Boiler Load Index (BLI), MFT etc. shall be provided on as required basis, for implementation of protections and interlocks. Contractor |

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| | shall provide Remote Input Output (RIO) for PLC per unit, placed in Central Equipment Room (CER) for the same. However, contractor to consider IOs and cables for minimum number of hardwired signal exchange per unit as follows DI – 80, DO – 80, AI – 20 and AO – 20. NTPC shall provide 2 (Two) nos. of 24V DC power supply feeders in CER for powering RIO panel. |
| 9.02.00 | Control, operation and monitoring of FGD and associated system being provided under the contract is primarily envisaged from Contractor's OWS placed in FGD control room. In addition to above, it is also envisaged to control, operate and monitor FGD and associated system remotely from main plant Central Control Room (CCR). To achieve the above the Contractor shall provide the following:<br><br>1) The FGD plant operation shall be made available through Ethernet link following TCP/IP standard. The system shall be OPC compliant.<br><br>2) Contractor shall provide necessary hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for transfer of signals. All required plant data shall be transferred to / from through links ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalized during detailed engineering.<br><br>3) The Contractor shall provide all assistance to the BOP C&I (in Employer's scope) supplier including co-ordination and flow of required information etc.<br><br>4) Contractor shall provide complete logics for FGD and associated system such as booster fan blade pitch control, FGD bypass damper control, FGD inlet and outlet gate control etc. FGD OEM shall furnish recommendations, if any, for implementation in employer's DDCMIS for boiler control. |
| 9.03.00 | Bidder to visit site to estimate the distance between FGD control room and Employer's CCR/CER. |
| **10.00.00** | **Grounding System**<br><br>Suitable electronic grounding is to be provided by the contractor for all C&I equipments/panels/desk in the scope of the contractor. The exact scheme shall be as finalized during detailed engineering. Also Refer tender drawing 0000-999-POI-019A and Sub-Section titled "Basic Design Criteria" in Part-B, of this Technical Specification. |

# SUB-SECTION-III-D

# CIVIL WORKS

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**1.00.00 SCOPE OF CIVIL WORKS**

1.01.01 Scope of Bidder shall include all Civil, Structural, Architectural works including underground facilities like drainage, sewerage, trenches, earthing mat/ grounding, of all the facilities associated with complete Flue gas desulfurization (FGD) system, Zero Liquid Discharge (ZLD) system & Chimney as specified elsewhere in the technical specification.

1.02.00 The work to be performed under this specification consists of providing all labour, materials, construction equipment, tools and plant, scaffolding, supplies, transportation, all incidental items not shown or specified, but reasonably implied or necessary for successful completion of the work including Bidder's supervision and in strict accordance with the drawings and specifications. The nature of work shall generally involve earthwork in excavation & deep underground excavation, extensive de-watering, shoring and strutting, sheet piling, back filling around completed structures and plinth protection, paving , disposal of surplus excavated materials, piling, concreting including reinforcement and form work, brick work, fabrication and erection of structural / miscellaneous steel works, inserts, architectural items & finishes such as plastering, painting, flooring, doors, windows & ventilators, glass and glazing, rolling shutters etc., permanently colour coated profiled steel sheeting, anchor bolts, R. C. C. trenches with covers, laying and testing of water pipes, sanitation, water supply, drainage, damp proofing, water proofing and other ancillary items.

1.03.00 The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, grounding, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, finishes, false ceiling and complete architectural works, etc.

The works covered under the scope of the bidder have to be executed in an operating ***/*** under construction power station. The bidder shall take all necessary precautions to protect the entire existing equipments, structures, facilities and buildings etc. from damage. In case any damage occurs due to activities of the bidder on account of negligence, ignorance, accidental or any other reason what so ever, the damage shall be made - good by the bidder at his own cost to the satisfaction of the Owner. The bidder shall take all necessary safety measures to avoid any harm, injury to his workers/staff from the equipment / facilities of the power station.

1.04.00 If during the execution of works it is found that there is interference with the existing facilities / structures, the bidder shall revise his design / detailed drawings to clear the interference and shall provide all necessary measures for the safety of existing structures. In case the details shown in tender drawings are found to be different from actual details at site, bidder shall revise his design/ detailed drawings to suit the constraints at site. No claim in terms of cost or relaxation in time shall be entertained for any redesign, rework and for safety measures provided. If at any stage of work, any dismantling or modification or relocation of any existing facility is required to be done to complete the work in bidder's scope and which has been agreed by the Employer, the same shall be done by the bidder at no extra cost or time implication to the Employer. All such changes will be as per drawings and work plan approved by the employer.

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| 1.05.00 | Analysis, design and preparation of construction drawings for all structure/facilities under the scope of this package and getting the same approved from the owner. |
| 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. |
| **2.00.00** | **CONSTRUCTION FACILITIES** |

The following are also in the Bidder's scope of work:

1. Providing drinking and service water for Bidder's labour, staff and other personnel working for Bidder at the work site and in his staff/ labour colony. He shall install necessary bore wells with associated pumping or water tankers and treatment facilities to supply quality water as per standards.

2. Developing temporary staff colony and labour colony along with fencing etc. Land if required shall be arranged by the Bidder himself.

   However space required for bidder's office, storage, pre assembly and fabrication areas shall be provided by owner free of charge within the plant premises.

   The area to be allocated to the Bidder shall be discussed & finalized with the bidder after the award, keeping in view the availability of free space & similar requirement of other agencies.

3. Providing all arrangements for distribution of construction power at various locations as per his requirements from the supply point of Owner.

4. Providing all arrangements for the supply of construction water including bore-wells, water tankers etc.

5. Providing temporary construction office, construction stores (open / covered), workshops, material / field testing laboratory, any other temporary buildings

6. Providing all construction equipment, labour and materials. The Bidder shall provide all the tools and tackles required for the work.

7. Development of the pre-assembly and storage yard with fencing, drainage, internal roads, boulder soling, etc.

8. Approach road to project site is available. Further, Owner intends to construct the roads as per the layout shown in the General Layout plan in a progressive manner. Some of these roads may not be available to the bidder for his use. Similarly the drainage network for the plant site being constructed by the owner may not be available to full extent. The bidder shall plan his work within the plant area considering the above constraints of roads and drains. Access roads to his work sites, offices, stores, preassembly / fabrication yard, etc. as required for providing approach/access for men, materials, equipment, cranes, trailor, construction/erection activities etc., what so ever are required by the bidder, shall be constructed and maintained by the bidder. Bidder shall provide permanent access to all facilities/ structures from the nearby existing roads of the owner. Roads shall be in

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concrete (M-35 grade) as per IRC standards, with minimum thickness of pavement (PQC) as 250mm. Width of all such roads shall be 7.5M concrete pavement.

9. Area lighting at the construction / erection site, pre-assembly and storage yard, office areas and labour / staff colony.

10. Providing all necessary fire-fighting devices / equipment / fire tender etc. required during the project execution stage. He shall maintain all such equipment / devices in proper working conditions throughout the period of work.

11. Providing first aid facilities at the construction / erection sites, workshops, laboratories, pre-assembly and storage yard and other places of work as per the requirement.

12. The Bidder shall arrange skilled / semiskilled / unskilled manpower from local source(s) as far as available in this country. He shall also arrange supervisory staff for quality execution of all works in his scope.

13. **Bidder's office, store, workshop, laboratory or any other temporary buildings:**

The Bidder shall adopt pre-engineered/ pre-fabricated constructions made of steel with single / double skin, insulated for un-insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for his site office, covered store workshop, laboratory or any other temporary buildings. Alternatively, bidder can adopt readymade `Portacabin' or similar construction. Bidder shall ensure that all such constructions are well-engineered, neatly constructed and overall present a pleasing look. The above requirements shall be applicable to his sub-vendors also and bidder shall be responsible for enforcing the same on his sub-vendors.

Any other type of construction if proposed by the bidder shall be subject to approval of the owner. However, such construction shall be based on proper design and shall have aesthetic look.

14. **Use of ash and ash based products:**

In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, Bidder shall use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill. The above requirements shall be applicable to his sub-vendors also and Bidder shall be responsible for enforcing the same on his sub-vendors.

15. **Repair & Maintenance Facilities by the Bidder:**

Bidder shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like cranes, hydra, forklifts, welding equipments, etc.) He will also make arrangements/tie up with manufacturers/ suppliers of such construction plant, equipment & machinery, for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
|---|---|

adequate stock of spares at site for various construction plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Bidder shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.

# SUB-SECTION-IV

# TERMINAL POINTS & EXCLUSIONS

| CLAUSE NO. | TERMINAL POINTS & EXCLUSIONS |
|---|---|
| **1.00.00** | **TERMINAL POINTS** |
| 1.01.00 | **FGD**<br><br>The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package. |
| 1.02.00 | **Flue Gas Duct**<br><br>(i) Un cleaned Flue Gas — For each unit:<br><br>i) One tapping from the common Flue Gas Duct going towards the existing Chimney (in case of twin flue chimney). No load of duct shall be transmitted on the Employers facilities.<br><br>ii) One tapping each from the two Flue Gas Duct going towards the existing Chimney (in case of single flue chimney). No load of duct shall be transmitted on the Employers facilities. |
| 1.03.00 | **Auxiliary Steam System** (For ZLD application)<br><br>Contractor shall take a tap off suitably from the existing Aux. steam header ( Pr. 16 ata, Temp-210 deg. C) available at BC bay below dearator floor. |
| 1.04.00 | **Equipment Cooling Water** |
| 1.04.01 | **Normal make up to ECW tank**<br><br>Contractor shall take a tap off suitably from the existing DM normal make up header ( DM normal make up pump discharge) available along C-row at CD bay rack for meeting the makeup water requirement of ECW system. The pressure available at TP will be 4Ksc (gauge) wrt FGL (approx.). |
| 1.04.02 | **Emergency make up to ECW tank**<br><br>Contractor shall take a tap off suitably from the existing DM Emergency make up header (condensate transfer pump discharge) available along C-row at CD bay rack for meeting the emergency make up water requirement of ECW system. The pressure available at TP will be 4 Ksc (gauge) wrt FGL (approx.). |

| CLAUSE NO. | TERMINAL POINTS & EXCLUSIONS |
|---|---|
| 1.05.00 | **Process Water**<br><br>For FGD system, Contractor shall take a tap off suitably from the existing CW blow down header available near the CW pump house. The pressure available at TP will be 1.9 Ksc (gauge) wrt FGL (approx..). |
| 1.06.00 | **Gypsum Wash Water (Clarified Water)**<br><br>For Gypsum washing, Contractor shall take a tap off suitably from the existing HVAC header (HVAC make up pump discharge) available along C-row at CD bay rack for meeting the water requirement of Gypsum washing. The pressure available at TP will be 4Ksc ( gauge) wrt FGL (approx.). |
| 1.07.00 | **Potable water**<br><br>Contractor shall take a tap off suitably from the existing potable water supply header (potable water pump discharge) available along C-row at CD bay rack for meeting the potable water requirement . The pressure available at TP will be 3Ksc ( gauge) wrt FGL (approx.). |
| 1.08.00 | **Waste Water**<br><br>FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank , and 300 mm above FFL in HCSD Silo Area. Pressure at terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be <50°C. |
| 1.09.00 | **Limestone**<br><br>i) For unloading of Limestone through WT/Track Hopper of the existing Coal Handling Plant, limestone 'Feed Point' before existing CHP's Crusher House.<br><br>ii) For unloading with Road-Truck Unloading System, entry to truck unloading area. |
| 1.10.00 | **Gypsum**<br><br>Outlet of Gypsum storage silo/shed |
| **1.11.00** | **FIRE DETECTION AND PROTECTION SYSTEM**<br><br>**(i) Mechanical:**<br>Separate Hydrant and spray header (within 100 metre) available in plant area for tapping required for Hydrant and spray system for FGD/ZLD facilities. Minimum pressure available for hydrant and spray system shall be 8 Kgf/cm2. |

| CLAUSE NO. | TERMINAL POINTS & EXCLUSIONS |
|---|---|
| 1.12.00 | All interconnections of matching flanges/expansion joints/piping/ducting etc, between employer supplied equipment/equipment supplied by other contractors and contractor supplied items at terminal points specified above shall, however, be in the scope of FGD Contractor. |
| 1.13.00 | **Electrical** |
| 1.13.01 | Terminal points of Contractor's electrical scope, applicable for all systems/ subsystems described in relevant clauses for SCOPE is given below:<br>(i) Terminals of Employers HT switchgear. |
| **1.14.00** | **Control & Instrumentation**<br>a) Employer's marshalling cabinets for hardwired signal exchange with Employer system.<br>b) Instrument air at one point (if required).<br>c) One (1) no. 240V, single phase, 50 Hz feeder per unit for meeting the unregulated AC power supply requirement for illumination, heating, ventilation, and utility outlets, etc. at bidder's Power supply distribution panel.<br>d) Two (2) 415 V, 3 – phase 3 wire, 50 Hz feeder for each set of the bidder's 24 V DC system. |
| **2.00.00** | **EXCLUSIONS** |

# SUB-SECTION-V

# SALIENT DESIGN DATA

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

**1.00.00** The Flue Gas Desulphurisation (FGD) System FOR KUDGI-I 3X800 MW, LARA-I 2X800 MW, GADARWARA-I 2X800 MW & DARLIPALLI-I 2X800 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:

| Sl. No | Item | Guarantee Point | Design Point |
|---|---|---|---|
| 1 | Boiler Load in MW (e) | 800 | VWO |
| 2 | Type of Coal | Worst coal | Worst coal |
| 3 | Ambient air condition | 27° C temp. and 60% RH | 45° C temp. and 60% RH |
| 4 | Coal Flow (T/hr) | 584 | 611 |
| 5 | Gas flow at the FGD inlet when firing respective coal ($Nm^3$/sec)* | 848 (1336 $m^3$/s) | 918 (1494 $m^3$/s) |
| 6 | Gas temperature at FGD inlet (deg.C) | 135 degree Celsius | 150 degree Celsius |
| 7 | Flue Gas Composition at FGD system inlet: | | |
| | (i) $O_2$ (% v/v wet) | 6.337 | 6.115 |
| | (ii) $CO_2$ (% v/v wet) | 10.868 | 10.501 |
| | (iii) $H_2O$ (% v/v wet) | 10.910 | 3.958 |
| | (iv) $SO_2$ (% v/v wet) | 0.067 | 0.065 |
| | (v) $N_2$ (% v/v wet) | 71.818 | 69.362 |
| | (vi) Inlet $SO_2$ (mg/$Nm^3$-wet) | 1915 | 1858 |
| | (vii) $NO_x$ | < 100 MG/$Nm^3$ at 6% $O_2$ | |
| | (viii) Dust (mg/$Nm^3$) | 50 | 200 |
| | (ix) $SO_3$ (ppm) | 10.50 | 10.20 |

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

| Sl. No | Item | Guarantee Point | Design Point |
|---|---|---|---|
| | (x) HCl (ppm)-wet | 45 | 45 |
| | (xi) HF (ppm)-wet | 12 | 12 |
| 8 | $SO_2$ removal Efficiency (Continuous) (%) | 96.55 | 96.55 |

* The flue gas volume in $Nm^3$/sec shall be calculated at 101.325 kPa and 273.15 K.

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

**2.00.00** The Flue Gas Desulphurisation (FGD) System FOR MOUDA-II 2X660 MW, TANDA-II 2X660 MW, NABINAGAR-I 3X660 MW, MEJA-I 2X660 MW & BARH-I 3X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:

| Sl. No | Item | Guarantee Point | Design Point |
|---|---|---|---|
| 1 | Boiler Load in MW (e) | 660 | VWO |
| 2 | Type of Coal | Worst coal | Worst coal |
| 3 | Ambient air condition | 27° C temp. and 60% RH | 45° C temp. and 60% RH |
| 4 | Coal Flow (T/hr) | 524 | 557 |
| 5 | Gas flow at the FGD inlet when firing respective coal ($Nm^3$/sec)* | 691 (1077 $m^3$/s) | 759 (1212 $m^3$/s) |
| 6 | Gas temperature at FGD inlet (deg.C) | 135 degree Celsius | 150 degree Celsius |
| 7 | Flue Gas Composition at FGD system inlet: | | |
| | (i) $O_2$ (% v/v wet) | 6.264 | 6.047 |
| | (ii) $CO_2$ (% v/v wet) | 9.876 | 9.546 |
| | (iii) $H_2O$ (% v/v wet) | 12.824 | 15.774 |
| | (iv) $SO_2$ (% v/v wet) | 0.073 | 0.070 |
| | (v) $N_2$ (% v/v wet) | 70.964 | 68.563 |
| | (vi) Inlet $SO_2$ (mg/$Nm^3$-wet) | 2087 | 2001 |
| | (vii) $NO_x$ | < 100 MG/$Nm^3$ at 6% $O_2$ | |
| | (viii) Dust (mg/$Nm^3$) | 50 | 200 |
| | (ix) $SO_3$ (ppm) | 10.5 | 10.2 |

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

| Sl. No | Item | Guarantee Point | Design Point |
|---|---|---|---|
| | (x) HCl (ppm)-wet | 45 | 45 |
| | (xi) HF (ppm)-wet | 12 | 12 |
| 8 | $SO_2$ removal Efficiency (Continuous) (%) | 96.91 | 96.91 |

* The flue gas volume in $Nm^3$/sec shall be calculated at 101.325 kPa and 273.15 K.

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

**3.00.00** The Flue Gas Desulphurisation (FGD) System for SOLAPUR-II 2X660 MW & MEJA-I 2X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:

| Sl. No | Item | Guarantee Point | Design Point |
|---|---|---|---|
| 1 | Boiler Load in MW (e) | 660 | VWO |
| 2 | Type of Coal | Worst coal | Worst coal |
| 3 | Ambient air condition | 27° C temp. and 60% RH | 45° C temp. and 60% RH |
| 4 | Coal Flow (T/hr) | 526 | 564 |
| 5 | Gas flow at the FGD inlet when firing respective coal ($Nm^3$/sec)* | 713 (1115 $m^3$/s) | 789 (1285 $m^3$/s) |
| 6 | Gas temperature at FGD inlet (deg.C) | 135 degree Celsius | 150 degree Celsius |
| 7 | Flue Gas Composition at FGD system inlet: | | |
| | (i) $O_2$ (% v/v wet) | 6.282 | 6.064 |
| | (ii) $CO_2$ (% v/v wet) | 10.491 | 10.139 |
| | (iii) $H_2O$ (% v/v wet) | 12.096 | 15.075 |
| | (iv) $SO_2$ (% v/v wet) | 0.071 | 0.068 |
| | (v) $N_2$ (% v/v wet) | 71.061 | 68.653 |
| | (vi) Inlet $SO_2$ (mg/$Nm^3$-wet) | 2030 | 1944 |
| | (vii) $NO_x$ | < 100 MG/$Nm^3$ at 6% $O_2$ | |
| | (viii) Dust (mg/$Nm^3$) | 50 | 200 |
| | (ix) $SO_3$ (ppm) | 10.5 | 10.2 |

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

| Sl. No | Item | Guarantee Point | Design Point |
|---|---|---|---|
| | (x) HCl (ppm)-wet | 45 | 45 |
| | (xi) HF (ppm)-wet | 12 | 12 |
| 8 | $SO_2$ removal Efficiency (Continuous) (%) | 96.91 | 96.91 |

* The flue gas volume in $Nm^3$/sec shall be calculated at 101.325 kPa and 273.15 K.

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

**4.00.00** The Flue Gas Desulphurisation (FGD) System for NABINAGAR 4X250 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:

| Sl. No | Item | Guarantee Point | Design Point |
|---|---|---|---|
| 1 | Boiler Load in MW (e) | 250 | VWO |
| 2 | Type of Coal | Worst coal | Worst coal |
| 3 | Ambient air condition | 27° C temp. and 60% RH | 45° C temp. and 60% RH |
| 4 | Coal Flow (T/hr) | 210 | 222 |
| 5 | Gas flow at the FGD inlet when firing respective coal ($Nm^3$/sec)* | 280 (424 $m^3$/s) | 307 (481 $m^3$/s) |
| 6 | Gas temperature at FGD inlet (deg.C) | 135 degree Celsius | 150 degree Celsius |
| 7 | Flue Gas Composition at FGD system inlet: | | |
| | (i) $O_2$ (% v/v wet) | 6.300 | 6.081 |
| | (ii) $CO_2$ (% v/v wet) | 9.988 | 9.652 |
| | (iii) $H_2O$ (% v/v wet) | 12.320 | 15.303 |
| | (iv) $SO_2$ (% v/v wet) | 0.072 | 0.069 |
| | (v) $N_2$ (% v/v wet) | 71.320 | 68.895 |
| | (vi) Inlet $SO_2$ ($mg/Nm^3$-wet) | 2059 | 1973 |
| | (vii) $NO_x$ | < 100 MG/$Nm^3$ at 6% $O_2$ | |
| | (viii) Dust ($mg/Nm^3$) | 50 | 200 |
| | (ix) $SO_3$ (ppm) | 10.50 | 10.20 |

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

| Sl. No | Item | Guarantee Point | Design Point |
|---|---|---|---|
| | (x) HCl (ppm)-wet | 45 | 45 |
| | (xi) HF (ppm)-wet | 12 | 12 |
| 8 | $SO_2$ removal Efficiency (Continuous) (%) | 96.91 | 96.91 |

* The flue gas volume in $Nm^3$/sec shall be calculated at 101.325 kPa and 273.15 K.

## 5.00.00 Chimney

**5.01.00** A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor. Clean gas from the absorber shall be taken to the Chimney through three stage mist eliminators. Treated flue gas from the absorber shall be discharged through a wet stack without reheating of the flue gas.

The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired, for the complete load range of operation and the expected numbers of Steam Generator start-ups while designing the Chimney flue liner considering Steam Generator in operation both with & without FGD system in operation. The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. The wet stack shall be designed as per the guidelines of EPRI Revised Wet Stack Design Guide.

| SN | Item | Design Condition |
|---|---|---|
| 1 | Boiler Load in MW (e) | VWO |
| | | |
| 2 | Gas flow ($M^3$/sec) | Design Point |
| 3 | Gas temperature at Chimney inlet (deg. C) | To be worked out considering Design Point conditions |

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

| | | |
|---|---|---|
| 4 | Flue Gas velocity (m/s) | < 18 at Design Point |

5.02.01 A wet stack study shall be performed by the Contractor for each unit with a wet stack installation where there does not exist an identical or mirror image installation that has already had a wet stack study performed. A wet stack model study shall consist of the following:

(i) Condensation calculations
(ii) Minimum 1:12 scale physical flow model for liquid collector design
(iii) Computational flow model for plume downwash analysis
(iv) Physical or computational flow model for CEMS elevation flow performance

5.02.02 Liquid collectors shall be designed and developed experimentally using a physical model. The model shall begin at the outlet of the absorber mist eliminator(s), include the absorber outlet and ducting, the stack breaching duct and a minimum of three (3) diameters of the stack liner above the top of the stack breaching duct. Physical model shall include any internal devices that may affect the gas flow, such as structural members, flow controls, and expansion joints. Liquid collectors shall be located where needed in the absorber outlet, the ductwork between the absorber outlet and the chimney liner, in the chimney liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to locations where it can be drained out of the system and prevent the discharge of droplets from the top of the stack that are large enough to rain out to the ground before evaporation.

| CLAUSE NO. | SALIENT DESIGN DATA |
|---|---|

**6.00.00 LIMESTONE CHARACATERSTICS**

| | | | |
|---|---|---|---|
| **Chemical Analysis(% by mass)** | | | |
| 1. | CaO | % | 47-51.0* |
| 2. | MgO | % | 0.9-2.0 |
| 3. | $Fe_2O_3$ | % | 0.45-1.0 |
| 4. | $Al_2O_3$ | % | 1.19-2.1 |
| 5. | $Si_2O_3$ | % | 2.1-4.5 |
| 6. | $Mn_2O_3$ | % | <0.12 |
| 7. | $P_2O_5$, | % | Traces |
| 8. | $Cl_2$ | % | <0.015 |
| 9. | $Na_2O$ | % | <0.16 |
| 10. | $K_2O$ | % | <0.01 |
| 11. | $TiO_2$ | % | <0.02 |
| 12. | Total Sulphur | % | <0.1 |
| 13. | LOI | % | 39.0-41.3 |
| **Physical properties** | | | |
| 1 | Bond Index | kWh/t | 13 |
| 2 | Granule size | | Medium |

**Note:**

1. *Guaranteed parameters (guarantee on limestone consumption, auxiliary power consumption & gypsum purity) shall be based on available (reactive) CaCO3 content of 89%. The design of Flue Gas Desulphurisation (FGD) system & auxiliaries shall be based on available (reactive) CaCO3 content of 79%.

2. For the purpose of volumetric computations of limestone handling & storage system the bulk density of limestone shall be taken as 1400 kg/m3. However for

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|---|---|

torque, drive & structural load requirements the density of lime stone shall be taken as 1700 kg/m3. For gypsum, the bulk density shall be taken as 900 kg/$m^3$ for volumetric computation and 1250 kg/m3 for torque, drive & structural load requirements.

**7.00.00 AIR CONDITIONING SYSTEM**

**GENERAL REQUIREMENTS**

1. All equipments shall be located indoor unless otherwise agreed to by the Employer. The equipment and layout shall generally be in accordance with the General Layout Plant drawings.
2. The layout of all equipment and accessories shall be developed in a way to facilitate easy accessibility and maintenance of all equipments.
3. Each equipment shall be provided with suitable lifting arrangement, e.g. Lifting lugs, eye bolts, etc to facilitate maintenance.

**7.01.00 DESIGN PHILOSOPHY FOR AIR CONDITIONING**

1. Design ambient conditions for all air conditioning system shall be as per **Appendix-A**
2. All equipments of Air Conditioning system shall be designed for continuous duty.
3. All air conditioned areas shall be maintained at 24 deg. C ± (plus or minus) 1 deg. C and relative humidity of 50% ± (plus or minus) 5%.
4. The fresh air quantity for air-conditioned areas of FGD Control Room etc. shall be 0.45 $M^3$/minutes/person or 1.5 air change per hour whichever is greater. Fresh air fan capacity shall be minimum 10% of the total CMH value of working indoor units.
5. Lighting load shall be minimum 2 Watts/Sq. feet.
6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room the same shall be one per 3 Sq.M. In the equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum).
7. In Air conditioning system for FGD Control Room, return air shall be routed back to AHU room through plenum space.
8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from

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the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder.

9. Soft water make up (if required) for complete air conditioning system shall be provided by the bidder in-line with terminal point specified in technical specification.

10. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec.

11. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec.

12. Requirement of Underdeck Insulation (for A/C area)

Underdeck insulation of 50 mm nominal thickness of glass wool (32 Kg/cu.m) or rock wool (48 Kg/cu.m) shall be provided if

i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area.

ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area.

iii) Underneath the ceiling of AHU room located below the A/C area or exposed to Atmosphere.

13. AHU's shall be provided with two stage of filteration i.e. pre and fine filter. All fresh air supply shall also be filtered using pre and fine filter.

14. A minimum design margin of ten (10) % shall be considered in design of A/C Plant Capacity for each area.

15. For areas, where A/C load is of the order of 25-60 TR, Direct Expansion (D-X) type Condensing unit (with AHU) shall be provided depending on the availability of space/ layout etc. For areas, where A/C load is of the order of 15-25TR, ductable split/packaged A/C shall be provided. Smaller areas which are away from the D-X type Condensing unit /central chilling units which may require air conditioning upto 15 TR rating shall be served with Hi-wall Split/Cassette air conditioner units as per requirement.

16. Insulation for supply and return air ducts: Supply and return ducts shall be insulated. All types of Insulation used for HVAC application shall be CFC/HCFC free.

**7.02.00 REDUNDANCY OF EQUIPMENTS**

**7.02.01** Redundancy of various A/C system equipments shall be as follows:

**a) FGD Control Room Building**

i) Air Cooled condensing units Air conditioners: 2X100%

ii) AHU (with VVVFD): 2 X 100%

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|---|---|

b) 100% standby shall be provided for area served by Cassette / Hi-wall Split /Ductable split AC/Package type air conditioners for all other control rooms covered in the scope of this package.

c) Fresh air fans shall be 1 x 100 % Capacity for each AHU room.

**7.03.00 DESIGN PHILOSOPHY – Ventilation System**

1. Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:

| | | | |
|---|---|---|---|
| i) | For all evaporative cooled areas | - | 8 |
| ii) | General areas | - | 20 |
| iii) | MCC / Switchgear rooms and Battery rooms& other areas where gaseous fumes/ vapours are generated | - | 30 |

2. However in areas producing lot of heat, temperature shall be the criteria as follows:-

a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas.

b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas.

**Note :** Dry bulb temperature during summer = 45 Deg C.

The criteria which gives higher number of air changes/higher quantity of air of either of condition (Cl. 1 or 2) flow shall be selected.

3. All ventilation systems shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated by means of supply air fans fitted with filters and exhaust fans for ventilation of heat generating areas combination of supply air fans with exhaust air fans shall be provided. MCC / switchgear and cable gallery areas shall be provided with gravity operated back draft dampers in association with supply air fans in order to maintain positive pressure. Battery rooms and other fumes/odour generating areas shall be negatively ventilated by means of exhaust air fans / roof exhausters and intake louvers. All other areas like pump house, Blower/compressor house (if any), etc shall be positively ventilated by a combination of supply air fan and exhaust air fan. Supply air fan catering for electrical areas (MCC & Switchgear rooms) shall be provided with pre-filters and fine filters and for other areas shall be provided with pre-filter only. For Positive ventilation CFM of exhaust air shall be 60% of CFM required for supply air. Similarly for

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negatively ventilated area, CFM of supply shall be 60% of total CFM exhaust.

4. All the equipments of Ventilation system shall be designed for continuous duty.

5. The supply air ducts of evaporative type ventilation system entering into switchgear room, cable galleries etc. shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating). Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder.

6. Circulating water Capacity for Air washer units shall be minimum 0.7 Cu.M/hr per 1000 Cu.M /hr of air flow. Velocity through piping shall be limited to 2.0 m/sec and for gravity flow the same shall be limited to 1.5 m/sec. Air distribution system shall be sized to have a constant frictional drop along its length and air velocity through ducts shall not exceed 12.5 m/sec.

7. For pumps, continuous motor rating (at $50^{O}$C ambient) shall be atleast 10% above the maximum load demand of the pump in the entire operating range.

   For fans, compressors and blowers continuous motor rating (at $50^{O}$C ambient) shall be atleast 10% above the maximum load demand at the design duty point.

8. Supply air fans, exhaust air fans & ventilations of each area shall be provided with local starter panels.

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|---|---|

**Appendix-A**

Outside Design Ambient condition to be considered for Air Conditioning system and ventilation System for various project/station are as under.

| Location | Season | Dry Bulb Temp. (Deg. C) | Wet Bulb Temp. (Deg. C) |
|---|---|---|---|
| Kudgi Stg-I (3x800) | Summer | 42.0 | 21.6 |
| | Monsoon | 32.6 | 26.6 |
| | Winter | 16.2 | 12.4 |
| | | | |
| LARA Stg-I (2x800) | Summer | 44.0 | 25.5 |
| | Monsoon | 31.0 | 27.7 |
| | Winter | 12.2 | 6.6 |
| | | | |
| Gadarwara Stg-I (2x800) | Summer | 44.0 | 25.5 |
| | Monsoon | 31.0 | 27.0 |
| | Winter | 12.2 | 6.6 |
| | | | |
| Darlipalli Stg-I (2x800) | Summer | 43.0 | 27.0 |
| | Monsoon | 34.0 | 28.0 |
| | Winter | 11.0 | 5.0 |
| | | | |
| Mouda Stg-II (2x660) | Summer | 43.5 | 25.5 |
| | Monsoon | 38.0 | 27.5 |
| | Winter | 15.0 | 10.0 |
| | | | |
| Solapur | Summer | 43.5 | 25.5 |

| CLAUSE NO. | SALIENT DESIGN DATA | | | |
|---|---|---|---|---|
| | STg-I (2x660) | Monsoon | 38.0 | 27.5 |
| | | Winter | 15.0 | 10.0 |
| | | | | |
| | Tanda-II STG-II (2x660) | Summer | 44.0 | 23.5 |
| | | Monsoon | 34.0 | 28.5 |
| | | Winter | 8.0 | 7.0 |
| | | | | |
| | Nabinagar JV STG-I (2x660) | Summer | 45.0 | 25.0 |
| | | Monsoon | 34.0 | 28.0 |
| | | Winter | 5.0 | 2.0 |
| | | | | |
| | Meja JV STG-I (2x660) | Summer | 44.0 | 23.5 |
| | | Monsoon | 34.0 | 28.5 |
| | | Winter | 8.0 | 7.0 |
| | | | | |
| | Barh Stg-I (3x660) | Summer | 43.0 | 27.5 |
| | | Monsoon | 38.0 | 29.5 |
| | | Winter | 7.0 | 5.8 |
| | | | | |
| | Nabinagar JV (RLY) Stg-I (4x250) | Summer | 45.0 | 25.0 |
| | | Monsoon | 38.0 | 28.0 |
| | | Winter | 5.0 | 2.0 |
| | | | | |
| | Rihand STG-II&III (2x500) | Summer | 43.9 | 25.6 |
| | | Monsoon | 35 | 28.9 |

| CLAUSE NO. | SALIENT DESIGN DATA | | | |
|---|---|---|---|---|
| | | Winter | 8.9 | 7.2 |
| | | | | |
| | Vindhyachal STG-III & IV (2x500) | Summer | 43.9 | 25.6 |
| | | Monsoon | 35.0 | 28.9 |
| | | Winter | 8.9 | 7.2 |
| | | | | |
| | Unchahar Stg-IV (1x500) | Summer | 43.9 | 25.6 |
| | | Monsoon | 35.0 | 28.9 |
| | | Winter | 8.9 | 7.2 |
| | | | | |
| | Kanti Stg-II (2x195) | Summer | 42.8 | 27.5 |
| | | Monsoon | 38.0 | 29.5 |
| | | Winter | 7.2 | 5.0 |
| | | | | |
| | Mouda Stg-1 (2X500) | Summer | 43.5 | 25.5 |
| | | Monsoon | 38.0 | 27.5 |
| | | Winter | 15.0 | 10.0 |
| | | | | |
| | Barh Stg-II (2x660) | Summer | 43.0 | 27.5 |
| | | Monsoon | 38.0 | 29.5 |
| | | Winter | 7.0 | 5.8 |
| | | | | |

| CLAUSE NO. | SALIENT DESIGN DATA |
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**8.00.00 Fire Detection and Protection System**

**8.01.00 General Design Criteria**

All major equipment/ system components in the entire fire protection & detection system shall have the approval from one of the following:

a) Underwriters laboratories of USA

b) LPCB-UK

c) VDS

d) BIS (for the approval of pumps and valves as applicable)

e) FM- USA

However design and installation of complete system and requirements shall be approved by TAC accredited professional(s)-India.

**8.02.00 Hydrant System**

Design philosophy (minimum requirement)

i) Category of Hazard and minimum terminal pressure shall be as TAC norms.

ii) All the landings of staircases, building, and other multi-storied structures of the plant shall be provided with hydrant landing valves.

iii) Each of the landing valves and external hydrant valves associated with FGD area shall be provided with a hose box. Each hose box shall contain two (2) numbers of 15M long hoses & coupling, branch pipes & nozzles, spanner etc as per TAC guidelines.

For landing valves of various buildings of FGD area, the hose box shall have two (2) numbers 7.5 m long hoses, branch pipes, couplings, nozzles, spanners, etc. as per TAC guidelines.

iv) The pipelines routed in RCC trenches shall be provided with coating and wrapping. Road, Rail or pipe trench crossing be through trestle/RCC hume pipes of appropriate pressure class and the pipe lines shall be provided with coating and wrapping as per specification.

**8.03.00 HVW & MVW Spray System**

Design Philosophy (Minimum Requirements)

i) Design discharge density shall be as per the rules of TAC and/ or NFPA standards.

ii) Deluge valve along with trims like pressure gauge, water motor gong, etc. shall be UL/FM or equivalent approved / listed. The deluge valve (auto resetting type) assembly shall consist of accessories such as water motor gong, alarm test valves, drip/drain valves, strainers for these valves, hydraulic releasing system, solenoid valves, etc. Further, the design

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features and make of all the projectors / spray nozzles shall be UL/FM or equivalent approved / listed.

iii) A strainer ('Y' type) be provided at upstream of deluge valve.

iv) Pressure switches be provided in spray and detector piping to exhibit "FIRE" and "SPRAY ON" annunciations and as well as for interlock.

v) Wet type pipe detector network shall be provided for spray system using quartzoid bulb detectors.

vi) Each of the outdoor deluge valve and accessories shall be provided with housing.

vii) Remote manual operation of the deluge valves shall be possible from the respective fire alarm cum control panel when the system is selected in remote manual mode. Apart from the automatic operation of the deluge valve, the system shall have provision for manual operation of the deluge valve by means of hand operated lever close to the deluge valve assembly. There shall also be a provision to operate deluge valve electrically from a nearby local panel.

8.04.00 **Fire Detection, Alarm and Control System**

**Design Philosophy (Fire Alarm and Detection System)**

i. The addressable type panels at FGD Control equipment rooms shall receive signal from sensors from various areas/ equipments of the respective units. This shall give audio-visual annunciations for fire in each of the risk area / equipment / status of the fire protection system as well as system operator open / short circuit status of detector or control cabling, etc. Further, this shall activate a hooter/sounder in each of the area provided with fire/smoke detection system

ii. Alarms from the FGD fire alarm panel shall be repeated simultaneously in repeater panel at Fire station. Also the fire alarms of this area has to be communicated to the main plant Fire alarm control panel through potential free contacts.

iii. The addressable panel shall evaluate the signals received from the detectors, transmit the fire or trouble alarms (audio-visual) to prearranged points, supervise and monitor the complete fire detection & extinguishing circuits, initiate control functions like shutdown of draft fans, air-conditioning and ventilation plant/equipment, closure of Fire dampers in A/C & Ventilation system etc. Opening smoke extraction vents, switching on smoke extraction equipment emergency lighting, tripping of transformer lockout relays etc.

iv. All the circuits from the detectors to the panels and the circuits from the panels to the actuating devices (such as solenoid valves, deluge valves, push buttons etc.) shall be closed loop type and shall be supervised for open and short circuiting. The trouble signal also be annunciated in the respective panels.

v. Facilities shall be provided on the fire alarm panel for simulating fire conditions, sensitivity adjustment, isolation of detectors etc. from the panel.

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**9.00.00 Compressed Air System**

**DESIGN CRITERIA / BASIS AND PERFORMANCE GUARANTEE**

1. All the equipments shall be designed for continuous duty and as well as for intermittent operation. Frequent start/stop of the system shall not result deterioration in performance nor damage to the equipment.
2. The compressors and Air Drying plants shall operate under the following ambient conditions.
   - i. Minimum temperature : 10 deg.C
   - ii. Maximum temperature : 50 deg. C
   - iii. Design condition (temperature & Relative humidity) : 45 deg.C& 75% RH
   - iv. Height above MSL (m) : Refer Chapter "Project Information"
3. The design ambient conditions for the motors shall be as mentioned in relevant Electrical sub-sections.

9.01.00 **Selection of Capacity of Air Compressor**

a) **Air Compressor**

**Air Compressor shall be designed to meet the Instrument air and service air requirement of all the equipments/plant/systems to be supplied by the Contractor for FGD Plant and ZLD plant (if applicable) as follows:-**

| Sl. No. | Continuous Requirement | Quantity (in $NM^3$/min) |
|---|---|---|
| 1. | Instrument air requirement for FGD plant (Continuous) | **A** |
| 2. | Instrument air requirement for ZLD plant (Continuous) | **B** |
| 3. | Service air requirement for FGD plant | **C** |
| 4. | Service air requirement for ZLD plant | **D** |
| **5.** | **Total Air requirement** | **= A+B+C+D** |
| **6.** | **Capacity of air compressor** | **= 2(A+B+C+D)** |

**Notes:** While calculating the air requirement of Bidder's equipments/plant/systems, for continuous requirements of instrument air and service air, no diversity factor shall be considered and they are to be assumed to be of "Simultaneous Requirements". The intermittent requirement of instrument air and service air, if any shall be converted into

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continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4.

1. The capacity of air drying plant shall be equal to the capacity of the individual air compressors. The Air drying plant, at its rated capacity, shall be designed to deliver continuously air at dew point of minus (-) 40 deg C at atmospheric pressure and the Quality of dry outlet air to conform to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air".
2. Discharge pressure available at the outlet of Air drying Plant shall be minimum 7.5 Kg/cm2 (g) or more as per the requirement of Contractor.
3. The discharge pressure of compressor shall be minimum 8.5 $Kg/cm^2$(g).
4. The heat exchangers are DMCW cooled and the maximum cooling water temperature at compressor coolers inlet to be considered same as that of PHE outlet cooled DMCW temperature.
5. The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C.
6. Noise level shall not exceed 90 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level.
7. Parallel operation of compressors shall be possible without any undue vibration and noise.
8. The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors.
9. All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.

| | |
|---|---|
| **10.00.00** | **LIMESTONE HANDLING PLANT** |
| 10.01.00 | Rated capacity of Limestone handling system from existing CHP shall be 1200 TPH upto crushed limestone storage system. Belt speed of conveyors shall not be more than 3.4 m/s. |
| 10.02.00 | All conveyors shall be designed for 110% of rated capacity. |
| | Rated capacity (corresponding to CHP capacity) shall be guaranteed capacity for 100% duty equipment. For 50% duty equipment design capacity shall be guaranteed capacity. |
| | For purpose of guaranteed power consumption rated capacity shall be considered in either case. |
| 10.03.00 | 2x100 %( one working + one standby) conveying stream shall be provided in the CHP. |
| 10.04.00 | Design capacity of the conveyor system shall be considered for the selection of belt width, belt speed and the continuous motor rating at 50 deg C Ambient |
| 10.05.00 | Belt conveyor system shall be designed as per the 5th edition of 'Belt Conveyors for Bulk Materials' published by Conveyor Equipment Manufacturer's Association' or equivalent |

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International Standard. **Ai** value for idler shall be considered 2.8lb (min.) for the purpose of conveyor design calculation only.

10.06.00 All mechanical, Electrical, civil and structural system design shall consider:

a) Simultaneous running of both conveyors at rated capacity.

b) Starting of one stream with other stream in standstill condition.

c) Starting of one stream with other stream in operation at rated capacity.

d) Round the clock operation of Limestone Handing Plant.

e) The following aspects shall be taken care of coal / limestone:

i) The limestone delivered to power station shall be of size 250mm and below. However, occasionally 1-2% coal of 400 mm lump size may also be encountered.

ii) Due to open cast method of mining involved, the coal may contain shale and sand stone as high as 20%. Also occasionally, metal pieces like broken shovel teeth, brake shoe, wires etc. may also come along with coal/ Limestone.

iv) The coal / limestone as received' shall contain varying percentage of fines. This may form adhesive lumps particularly during monsoon when surface moisture is at its maximum value. The sizing and selection of all equipment shall take care of above.

f) For volumetric computations of limestone handling system the bulk density of limestone shall be taken as 1400 kg/m3. However for torque & drive requirements the density of lime stone shall be taken as 1700 kg/m3. For gypsum, the bulk density shall be taken as 900 kg/m3 for volumetric computation and 1250 kg/m3 for torque and drive requirements.

10.07.00 **LHP EQUIPMENT**

**a) Design capacities & margins**

| Sl no | Equipment | Duty requirement | Design capacity as %age of duty requirement |
|---|---|---|---|
| 1 | Crushers | 2x50% or 1x 100% | 110% |
| 2. | Vibrating feeders | 2x50% or 1x 100% | 110% |
| 3. | Paddle feeders | 1x 100% | 150% |
| 4 | Belt feeder for crusher house | 2x50% or 1x 100% | 110% |

10.08.00 **Drive equipment Rating**

Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors

a) For conveyors of belt conveyor systems *120% of actual power at drive motor output

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| | | shaft at specified design capacity |
| | b) Crushers, monorail hoists (travel and hoisting), elevators, rack and pinion gates, all the drives in sampling units, various pumps of DS/DE systems, service water systems, cooling water system, potable water system and sump pumps, Ventilation Fans. | *110% of actual power requirement at drive motor output shaft at guaranteed (rated) capacity. |

*The actual power at drive motor output shaft shall be calculated after considering all the losses of down the line equipment's of the drive train.

**Gear Box Rating :**

a) For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity}

In any case, gear box rating shall not be less than motor nameplate rating.

b) For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment }

@ Service factor shall include all the components considered by the supplier and should be clearly indicated in manufacturer's gear box selection catalogues

**Coupling**

Not less than motor nameplate rating.

10.09.00 **Hoists**

| Drive | |
|---|---|
| (i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings | Motor driven for both travel & lift. |
| (ii) Other hoists including the hoists for handling takeup pulley and takeup weight | Manual for both travel & lift. |

10.10.00 **Belt Scale**

Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of at least (±) 0.25 percent throughout its range.

10.11.00 **Belting and Pulleys for 1200 TPH**

a) Belt ratings shall be selected in such a way that there are only three (3) ratings for Nylon/Nylon belting and maximum two (2) ratings of steel cord belting. This however excludes sealing belt (for sealing slots of tripper floor) and belting of belt feeders. (Belting shall be completely interchangeable among same rating of belt.) Minimum number of plies for belting shall be four (4). Other details of belting shall be as specified else where in the specification.

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(b) For Pulley, following minimum parameters shall be followed:

(1.) Shell thickness : 20 mm (Min.)

(2.) End disc plate thickness : 30 mm(Min.)

(3.) Maximum allowable deflection of shaft at hubs : 5 Minutes

(4.) Diameter :

(i) All drive pulleys : 800 mm dia (min.)
1000 mm dia (min.) (In case of steel cord belts)

(ii) All balance pulleys : 630 dia (min)

**Belting and Pulleys for 150TPH rated conveying capacity (LHP &GHP)**

(a.) Belt ratings shall be selected in such a way that there are only three (3) ratings of belting. This however excludes and belting of belt feeders. Belting shall be completely interchangeable among same rating of belt.

(b) Minimum number of plies shall be three (3). Other details of belting shall be as specified elsewhere in the specification.

(c) For Pulley, following minimum parameters shall be followed:

(1.) Maximum allowable deflection of shaft at hubs : 5 Minutes

(2.) End disc plate thickness : 12 mm (min.)
Shell plate thickness : 12 mm (min.)

(3.) Diameter:

(i) All drive pulleys : 630 dia (min)

(ii) All balance pulleys : 500 dia (min)

Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.

d) Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to three (3) nos. These shall comprise of two (2) nos. drive pulleys & one (1) no. for all balance pulleys excluding tripper & SS pulleys.

10.12.00 Bulk density of limestone & gypsum shall be considered as follows:

| | Limestone | Gypsum |
|---|---|---|
| a) For volumetric computation | -1400 kg/$m^3$ | 900 kg/$m^3$ |
| b) For load/ strength | - 1700 kg/$m^3$ | 1250 kg/$m^3$ |

10.13.00 2x100 %( one working + one standby) conveying stream shall be provided in the limestone and gypsum handling system.

10.14.00 The covered storage shed/silo for limestone shall be sufficient to store limestone equivalent to consumption of minimum 7 days. The covered storage shed for gypsum shall be sufficient to store gypsum equivalent to generation of minimum 7 days.

Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.

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Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to five (5). These shall comprise of two (2) nos. drive pulleys and three (3) nos. for all balance pulleys. Pulleys for Belt Feeder, fixed &travelling tripper, SS pulleys & S/R pulleys are not included in the above categories

10.15.00 **Dust extraction system**

Type : Venturi scrubber type

Location : Belt feeder after crusher & Vibrating Screening

Feeder at crusher house.

10.16.00 **Service Water System**

Service water connections are to be provided in conveyor galleries & tunnels at 50 meter interval and one (1) no. on each floor of Transfer Points, toilets and minimum two (2) nos. on each floor of crusher house.

(a.) Flow at each valve : 5 cub.m/hr

(b.) Minimum discharge

Pressure at tap point : 2 kg/sq.cm

(c) No. of valves operated : 6 nos.

Simultaneously

10.17.00 **Ventilation System**

**A. Mechanical Ventilation System:**

i. Underground Areas: Minimum 15 supply air changes and minimum 7 exhaust air changes per hour.

ii. Other Areas Minimum 10 supply air changes per hour.

**B. Pressurized Ventilation System**: Minimum 15 supply air changes per hour

10.18.00 **Chutes:**

Minimum clear cross section of chute: 1000 mm X 800 mm (inside both ways)

**11.00.00 LIMESTONE HANDLING PLANT AND GYPSUM HANDLING PLANT**

11.01.00 The coal conveyors shall also be suitable for handling limestone unloaded at wagon tipplers/ track hopper and being conveyed to limestone crusher house at 1200 MTPH (min). Limestone conveyors before crusher house and upto storage shed shall be rated for 1200 MTPH(min.). The rated capacity of limestone reclaimer conveyors from storage shed to limestone mill bunkers shall be 150TPH. The rated capacity of all gypsum handling conveyors shall be 150TPH.

11.02.00 **Belting and Pulleys for 150TPH rated conveying capacity (LHP &GHP)**

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(a.) Belt ratings shall be selected in such a way that there are only three (3) ratings of belting. This however excludes and belting of belt feeders. Belting shall be completely interchangeable among same rating of belt.

(b) Minimum number of plies shall be three (3). Other details of belting shall be as specified elsewhere in the specification.

(c) For Pulley, following minimum parameters shall be followed:

(1.) Maximum allowable deflection of shaft at hubs : 5 Minutes

(2.) End disc plate thickness : 12 mm (min.)

Shell plate thickness : 12 mm (min.)

(3.) Diameter:

(i) All drive pulleys : 630 dia (min)

(ii) All balance pulleys : 500 dia (min)

Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.

d) Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to three (3) nos. These shall comprise of two (2) nos. drive pulleys & one (1) no. for all balance pulleys excluding tripper & SS pulleys.

11.03.00 Bulk density of limestone & gypsum shall be considered as follows:

| | Limestone | Gypsum |
|---|---|---|
| a) For volumetric computation | -1400 kg/$m^3$ | 900 kg/$m^3$ |
| b) For load/ strength | - 1700 kg/$m^3$ | 1250 kg/$m^3$ |

11.04.00 2x100 %( one working + one standby) conveying stream shall be provided in the limestone and gypsum handling system.

11.05.00 The covered storage shed/silo for limestone shall be sufficient to store limestone equivalent to consumption of minimum 7 days. The covered storage shed for gypsum shall be sufficient to store gypsum equivalent to generation of minimum 7 days.

# SUB-SECTION-VI

# FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

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**FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE TESTS**

**1.00.00 GENERAL**

The term “Performance Guarantees” wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to “Functional Guarantees”. Similarly the term “Performance Tests” wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to “Guarantee Test(s)”.

**2.00.00 PERFORMANCE GUARANTEES / PERFORMANCE TESTS**

2.01.00 **General Requirements**

2.01.01 The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.

2.01.02 The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes.

2.01.03 The Contractor shall conduct performance test and demonstrate all the guarantees covered herein. The various tests which are to be carried out during performance guarantee tests are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.

2.01.04 All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.

2.01.05 The performance tests shall be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.

2.01.06 It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests.

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2.02.00 **Test Instrumentation, Flow Measurement and their Calibration**

2.02.01 All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Contractor shall get these instruments calibrated in an independent test Institute approved by the Employer and submit the same to Employer prior to commencement of test. All test instrumentation required for performance tests shall be supplied by the Contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Employer prior to commencement of test. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Contractor free of cost.

The Performance test shall be carried out as per the agreed procedure. The detailed PG test procedure shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.

2.02.02 The P&G test procedures shall be submitted for equipments/system & subsystem under Contractor's scope for all Guarantees as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.

2.02.03 The Contractor shall submit for Employer’s approval the detailed Performance Test procedure containing the following:

(a) Object of the test.

(b) Various guaranteed parameters & tests as per contract.

(c) Method of conductance of test and test code.

(d) Duration of test, frequency of readings & number of test runs.

(e) Method of calculation.

(f) Correction calculations & curves.

(g) Instrument list consisting of range, accuracy, least count, and location of instruments.

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(h) Scheme showing measurement points.

(i) Sample calculation.

(j) Acceptance criteria.

(k) Any other information required for conducting the test.

2.03.00 **Test Reports**

After the conductance of Performance test, the Contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the Employer after completing each test run. Four (4) hard copies and two (2) soft copies on CD-ROM of each test report of final conducted test on each equipment/plant/system shall be submitted to Employer for approval.

2.03.01 Performance Guarantee Tests on the equipments/systems not covered in this Sub-section shall be carried out as per the procedure/test codes specified in respective detailed specifications.

2.04.00 **Acceptance of Guarantee Test Results**

**(i) For Category-I Guarantees**

In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit as specified at **clause 3.00.00** of this sub-section, Employer will accept the equipment/system/plant after levying liquidated damages as per **clause 3.00.00** of this sub-section. However, if, the demonstrated performance guarantee(s) continue to be beyond the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

Reject the equipment / system / plant and recover from the Contractor the payments already made

OR

Accept the equipment /system/ plant after levying Liquidated Damages. The liquidated damages for shortfall in performance indicated in clause 3.00.00 of this sub-section shall be levied separately for each unit. The rates indicated in clause 3.00.00 of this sub-section are on per unit basis. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies.

**(ii) For Category-II Guarantees**

In case during performance guarantee test(s) it is found that the equipment/ system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met even after the above modifications/replacements with in ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

Reject the equipment /system / plant and recover from the Contractor the payments already made.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as “Category-II” Guarantees.

**3.00.00 AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE FOR GUARANTEES FOR EACH PROJECT**

The rate of liquidated damages and acceptable shortfall limits for different guarantees shall be as under and such liquidated damages shall be deducted from the Contract Price of the project.

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**KUDGI-I (3X800 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 63,704/- (US Dollar Sixty Three Thousand Seven Hundred Four only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value. | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 249,736/- (US Dollar Two Hundred Forty Nine Thousand Seven Hundred Thirty Six only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 6032/- (US Dollar Six Thousand Thirty Two Dollars only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**LARA-I (2X800 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 63,704/- (US Dollar Sixty Three Thousand Seven Hundred Four only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 2494/- (US Dollar Two Thousand Four Hundred Ninety Four only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**GADARWARA-I (2X800 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 63,704/- (US Dollar Sixty Three Thousand Seven Hundred Four only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 2845/- (US Dollar Two Thousand Eight Hundred Forty Five only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**DARLIPALLI-I (2X800 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 63,704/- (US Dollar Sixty Three Thousand Seven Hundred Four only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 2258/- (US Dollar Two Thousand Two Hundred Fifty Eight only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**MOUDA-II (2X660 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 3299/- (US Dollar Three Thousand Two Hundred Ninety Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**SOLAPUR-I (2X660 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 6970/- (US Dollar Six Thousand Nine Hundred Seventy only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**TANDA-II (2X660 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 4831/- (US Dollar Four Thousand Eight Hundred Thirty One only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**NABINAGAR JV BIHAR-I (3X660 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 249,736/- (US Dollar Two Hundred Forty Nine Thousand Seven Hundred Thirty Six only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 2484/- (US Dollar Two Thousand Four Hundred Eighty Four only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**MEJA JV-I (2X660 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 52,393/- (US Dollar Fifty Two Thousand Three Hundred Ninety Three only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 243,718/- (US Dollar Two Hundred Forty Three Thousand Seven Hundred Eighteen only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 3697/- (US Dollar Three Thousand Six Hundred Ninety Seven only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**BARH-I (3X660 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 55,537/- (US Dollar Fifty Five Thousand Five Hundred Thirty Seven only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 222,157/- (US Dollar Two Hundred Twenty Two Thousand One Hundred Fifty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 1899/- (US Dollar One Thousand Eight Hundred Ninety Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

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**NABINAGAR JV RLY-I (4X250 MW)**

| Sl.No | Guarantee | Rate of Liquidated Damage (LD) | Acceptable Shortfall Limit with LD |
|---|---|---|---|
| i) | For shortfall in guaranteed $SO_2$ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI. | US $ 21,045/- (US Dollar Twenty One Thousand Forty Five only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value | (-)0.25% point from the guaranteed SO2 removal efficiency. |
| ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI. | US $ 255,904/- (US Dollar Two Hundred Fifty Five Thousand Nine Hundred Four only) for every 100 kg/hr increase in Limestone consumption from guaranteed value. | (+)10% of the guaranteed limestone consumption. |
| iii) | **Auxiliary Power Consumption**<br>For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI. | US $ 2129/- (US Dollar Two Thousand One Hundred Twenty Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value. | (+)1% of the guaranteed auxiliary power consumption |

**NOTES APPLICABLE FOR EACH PROJECT**:

i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.

ii) If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract.

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iii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC)

iv) Contractor's aggregate liability to pay Liquidated Damages (LD) for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price.

v) The LD values are applicable on per unit basis.

**4.00.00 GUARANTEES PARAMETERS**

4.01.00 **Guarantees Under Category-I**

**The Performance Guarantees which attract Liquidated Damages (LD) are as follows:**

The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI:

**(i) SO2 removal Efficiency**

The Contractor shall Guarantee that $SO_2$ removal efficiency at guarantee point (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) shall not be less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project). (To be conducted as per the stipulation of Cl. no. 6.00.00 of this sub-section.)

**(ii) Limestone consumption of FGD system**

Limestone consumption of FGD system in kg/hr under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) and SO2 removal efficiency of not less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project)

**(iii) Auxiliary Power Consumption**

The Contractor shall guarantee the total auxiliary power consumption for the FGD plant in normal operation at the guarantee point conditions, as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project, inline with the requirements stipulated in clause 5.00.00 of this Sub-Section.

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**4.02.00** **Guarantees Under Category-II**

**The parameters/capabilities shall be demonstrated for various systems/ equipments shall include but not limited to the following:-**

**(i) Wet ball Mill capacity at rated fineness**

The contractor shall demonstrate the guaranteed capacity of each limestone pulverizer under the following conditions:

i) Limestone fineness : 90% or higher (as per the requirement of the absorber) through 325 mesh.

ii) Limestone Quality : All available quality from the specified range.

**(ii) Wet ball Mill wear parts guarantee**

Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in Part B of the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation.

**(iii) Wet ball Mill ball consumption**

Contractor shall guarantee ball consumption per ton of limestone throughput in line with requirements stipulated in Part B of the Technical Specification. Contractor shall furnish the minimum ball diameter below which the balls shall be replaced.

**(iv) Vacuum Belt Filter Capacity**

Contractor shall demonstrate the Designed Capacity of the Vaccum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in Part B of the Technical Specification.

**(v) Gypsum Purity**

The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm and the moisture content shall not be more than 10% for guarantee point condition.

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**(vi) Waste Water**

The Contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be $10m^3$/hr averaged over a 24 hour period from each unit.

**(vii) Performance characteristics of fans (capacity, head developed, etc.).**

**(viii) Margins on fans in case Booster Fan is provided by the Contractor.**

Booster Fans - As specified in Part B of **Technical Specifications**

**(ix) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building:** Over load tests, travel and hoist speed checks.

**(x) Noise**

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in Part-C of Section-VI of the technical specifications.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or is 9779.

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. additional measurement points shall be considered based on the applicable standards and the size of the equipment. the measurement shall be done with slow response on the a - weighting scale. the average of a-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. corrections for background noise shall be considered in line with the applicable standards. all the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.

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**(xi) Mist Outlet Droplet Content**

The mist eliminator outlet droplet content shall be guaranteed to be $\leq$ 20 mg/Nm3 at absorber outlet measured over a period of 24 hrs continuous operation.

Mist outlet-droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer.

**(xii) Availability of FGD Plant**

The Contractor shall guarantee the maximum availability of FGD Plant for the range of coal and limestone specified inline with the requirements stipulated in clause 7.00.00 of this Sub-Section

**(xiii) Air Conditioning System**

**A. Following shall be demonstrated at Shop**

1) Capacity and static pressure of AHU fans at its rated duty point.

**B. Following shall be demonstrated at Site**

1) Capacity (TR) of air cooled condensing units (D-X type) for A/C system of FGD control room building.

2) Guaranteed room conditions during summer for all the Air conditioned areas.

3) Vibration and noise level of condensing units & centrifugal fans of AHUs.

**(xiv) Ventilation System**

**A. Following shall be demonstrated at Shop**

1) Capacity and discharge pressure of pumps of UAF units at its rated duty point of Ventilation system.

2) Capacity and static pressure of UAF fans at its rated duty point of Ventilation system.

**B. Following shall be demonstrated at Site**

1) Vibration & Noise level of centrifugal fans & pumps of UAF units.

**(xv) Compressed Air System**

a) Following shall be demonstrated at shop:

i) Capacity and discharge pressure of each air compressor.

b) Following shall be demonstrated at site:

ii) Dew point of air at the outlet of air drying plants of air compressor.

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iv) Pressure drop across air drying plant .

v) Vibration and noise level of air compressors, blowers of air drying plant (if applicable)

**xvi) Equipment Cooling Water System**

i) Vibration, noise and parallel operation without hunting & abnormal noise and with flow sharing within 10% of each other at the rated duty point shall be demonstrated at site.

ii) Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site.

**xvii) Waste Water Treatment System (Applicable for Barh-I (3X660 MW) & Nabinagar (4x250 MW)**

The Contractor shall guarantee the followings.

A). Wastewater treatment capacity($m^3$/hr) : ≥ 30 for **Barh-I (3X660 MW)**

B). Wastewater treatment capacity($m^3$/hr) : ≥ 20 for **Nabinagar (4x250 MW)**

C). Operating time : 16hr for Pre-treatment process, 24hr for Evaporation process

D). The distillate quality (Evaporator and crystallizer combined) shall be a maximum of 50 ppm TDS at 120 $^oF$, while the solids produced for disposal which will pass the paint filter test.

**5.00.00 AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT**

The unit auxiliary power consumption shall be calculated using the following relationship.

$P_a = P_u + T_L$

$P_a$ = Guaranteed Auxiliary Power Consumption.

$P_u$ = Power consumed by the auxiliaries of the unit under test.

$T_L$ = Losses of the transformers supplied by bidder based on works test reports.

While guaranteeing the auxiliary power consumption of each project the bidder shall necessarily include all continuously operating auxiliaries under this package. The auxiliaries to be considered shall include but not be limited to the following:

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i. Absorber Recirculation Pump(s)/Gas Cooling Pumps

ii. Absorber Oxidation Air Blower(s)

iii. Absorber Oxidation Tank Agitator(s)

iv. Gypsum Bleed Pump

v. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project

vi. Limestone Slurry Pump

vii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries divided by the number of units in the project

viii. Power consumption of Booster water pump (if provided) divided by the number of units in the project.

ix. Process water pump(s) divided by the number of units in the project

x. Mist Eliminator Wash Water pump(s)

xi. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project

xii. DM Cooling (normally working) Water pump one(1) to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system.

xiii. Auxiliary Cooling (normally working) water pump one(1) to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system.

xiv. Booster Fans

xv. Power consumption of Limestone Slurry Tank Agitator(s) divided by the number of units in the project

xvi. Power consumption of Filtrate Pump divided by the number of units in the project

xvii. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project

xviii. Power consumption of Cloth Wash Water Pump divided by the number of units in the project

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xix. Power consumption of Hydro-cyclone and Waste Water Pump divided by the number of units in the project

xx. Power consumption of all other continuous running Agitators divided by the number of units in the project

xxi. Air Conditioning System (*)

Total Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building and ZLD Control Room Building (if provided) divided by total nos. of units in respective project..

xxii Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)

((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of air washer units and at an elevation of RL (+) - m for both AHUs and Air washer unit centrifugal fans.)

xxiii Total power consumption at motor input terminal at rated duty of Air compressor, Air drying plant (Heater and blower, as applicable) divided by total nos. of units in respective project

xxiv. Power consumption of Evaporator feed pump divided by the number of units in the project, in case ZLD system is provided

xxv. Power consumption of Evaporator/Brine concentrator recirculation pump divided by the number of units in the project, in case ZLD system is provided

xxvi. Power consumption of Distillate pump divided by the number of units in the project, in case ZLD system is provided

xxvii. Power consumption of Crystalliser feed pump divided by the number of units in the project, in case ZLD system is provided

xxviii. Power consumption of Crystalliser recirculation pump divided by the number of units in the project, in case ZLD system is provided

xxix. Power consumption of Mechanical vapour Compressor divided by the number of units in the project, in case ZLD system is provided

The equipment's listed above for calculating auxiliary power consumption are indicative. Any other equipment required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption. Power consumption of all equipments provided on unitized basis shall be included in the unit auxiliary power consumption. For common station auxiliaries, the power

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consumption shall be assigned to each unit based on unit load for the purpose of calculating the unit auxiliary power consumption.

**Note :**

1. The bidder shall furnish a list of equipments to be covered under auxiliary power consumption, which shall be subject to Employer's approval.
2. The equipments listed above for calculating auxiliary power consumption are indicative. Any other equipment required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption.

**6.00.00 METHOD OF COMPUTING TEST EFFICIENCY OF FGD**

The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes. The details of the test shall, however be mutually agreed upon between the employer and the contractor.

**7.00.00 METHOD OF COMPUTING AVAILABILITY**

The Contractor shall guarantee 98 % availability of FGD plant including waste water treatment system for Zero Liquid Discharge (ZLD), wherever provided, for a continuous period of 120 days. An availability guarantee test shall be conducted to assure this level of availability for a period of 240 days as per the procedure indicated below.

Availability 'A' in %:

$$A = \frac{Tc \times 100\%}{Tk}$$

Tc – recorded time of FGD operation, expressed in hours,

Tk – recorded time of boiler operation, expressed in hours,

However, it is required that:

(i) In order to calculate the FGD availability, operation hours will be counted except boiler start-ups when the operation hours counting will start on the moment of shut down of all oil burners,

(ii) FGD will be regarded as a FGD in operation, when by-pass damper is closed and total flow of flue gas from boiler goes via FGD, and SO2

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content is below 100 mg/Nm3 (dry basis at 6% $O_2$) in cleaned flue gas for the range of specified coals & loads.

(iii) If FGD is out of operation during the boiler operation time as a result of the Employer's decision, this time will not be counted as boiler operation time for calculating the FGD availability,

(iv) Boiler operation hours will be counted based on the recorded boiler operation hours and the recorded data will be made available to the Contractor by the Employer.

Mandatory spares have been identified in the Employer. Contractor can use the mandatory spares supplied under the contract during this period in agreement with the Employer. However, if other additional spares are required for demonstration of availability demonstration guarantee, Bidder to should clearly indicate along with their offer.

If the calculated availability after 120 days availability test is lower than the guaranteed value, the Contractor will undertake actions as per clause 2.04.00 (ii) of this Sub-Section to achieve the guaranteed availability.

# SUB-SECTION-VII

# MANDATORY SPARES

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

**1.00.00** **GENERAL**

The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and Recommended spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:

1.01.00 **MANDATORY SPARES**

a) The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.

b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by **) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as 'set' (marked by*) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings.

c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly.

d) The Employer reserves the right to buy any or all the mandatory spare parts.

e) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.

f) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.

g) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.

1.02.00 **RECOMMENDED SPARES**

a) In addition to the spare parts mentioned above, the Contractor shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Forms & Price Schedules. This list shall take into consideration the mandatory spares specified in this Sub-Section and should be independent of the list of the mandatory spares. The Employer reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment.

b) Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.

1.03.00 **START-UP & COMMISSIONING SPARES**

a) Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the Plant is handed over to the Employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.

1.04.00 The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:

| CLAUSE NO. | MANDATORY SPARES |
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| | |
|---|---|
| **2.00.00** | The Contractor shall indicate the service expectancy period for the spare parts (both mandatory and recommended) under normal operating conditions before replacement is necessary. |
| **3.00.00** | All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccators packs as necessary. |
| **4.00.00** | All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan. |
| **5.00.00** | The Contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares. |
| **6.00.00** | Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification. |
| **7.00.00** | All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer. |
| **8.00.00** | The Contractor will provide the Employer with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/components/ equipments covered under the Contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors. |
| **9.00.00** | The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship. |
| **10.00.00** | In addition to the recommended spares listed by the Contractor, if the Employer further identifies certain particular items of spares, the Contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires. |
| **11.00.00** | The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall |

guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Sub-Contractors, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items.

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

## Mandatory Spares List (For Each Project)

| Sl. No. | Description | Nos. / Sets for Each Project |
|---|---|---|
| **1.01.00** | **A. Booster Fans** | |
| | 1. Fan assembly (excluding fan body) | 1 no. |
| | 2. Booster fan motor | 1 no. |
| | 3. Fan bearings | 1 set |
| | 4. Booster fan motor bearings | 1 set |
| | 5. Spares for blade bearing Assembly | |
| | 5.1 Bearings | 2 sets |
| | 5.2 'O' rings | 2 sets |
| | 5.3 Bushes | 2 sets |
| | 5.4 Metallic rings | 2 sets |
| | 5.5 Intermediate piece (if applicable) | 1 sets |
| | 6. Lube Oil / Hydraulic Oil system | |
| | 6.1 Pump assembly | 1 nos. of each type |
| | 6.2 Pump motor | 1 no. of each type & rating |
| | 6.3 Pressure regulator | 2 nos. |
| | 6.4 Filters | 2 nos. |
| | 6.5 Coupling between oil pump & motor | 1 nos. |
| | 7. Fan Blades | 1 sets |
| | 8. Coupling between Fan & Motor | 1 sets. |
| | 9. Hydraulic servomotor | 1 no. |
| | 10. Booster fan impeller liner | 1 sets |
| | 11. Booster fan casing liner | 1 set |

| | | |
|---|---|---|
| **1.02.00** | **Gates in Flue Gas System** | |
| | 1. Seals | 1 set of each type<br>(Set means complete replacement for one gate) |
| | 2. Actuator | 1 no. of each type & rating |
| | 3. Expansion joint | 1 number for each type and size |
| | 4. Seals for guillotine gate(Both port side and bonnet side) (In case Gates are provided) | 1 set for each gate |
| **1.03.00** | **Not Used** | |
| **1.04.00** | **Absorber** | |
| | 1. Liner Material | 5% coverage of each material and thickness for one Unit/Absorber |
| | 2. Absorber Spray/Oxidation nozzles | 10% of each type and size |
| | 3. Absorber Mist Eliminator Washing Nozzles | 10% of each type and size |
| | 4. Absorber Mist Eliminator | 5% of each type and size/configuration |
| **1.05.00** | **Oxidation Air Blower** | |
| | 1. Impeller Assembly | 1 no. |
| | 2. Bearings | 1 no. of each type |
| **1.06.00** | **(A) Agitators**<br>(For Absorber Oxidation Tank & Aux. Absorbent/Emergency tank), | |
| | 1. Impeller Assembly | 1 no. of each type and size |
| | 2. Bearing Assembly | 1 no. of each type and size |

| | | |
|---|---|---|
| | 3. Motor | 1 no. of each type and size |
| | 4. Belt and Pulley (If applicable) | 1 no. of each type and size |
| | 5. Gear Box Assembly (If Applicable) | 1 no. of each type and size |
| | 6. Agitator shaft assembly | 1 no. of each type and size |
| | 7. Shaft seal | 1 no. of each type and size |
| | 8. Complete Agitator assembly | 1 no. of each type and size |
| | (B) AGITATORS for Mill Separator Tank, Limestone Slurry Preparation Tank, Secondary hydroclone feed, Waste water, Filtrate tank and any other tank provided with agitators) | |
| | 1. Impeller Assembly | 1 no. of each type |
| | 2. Bearing Assembly | 1 no. of each type |
| | 3. Motor | 1 no. of each type |
| | 4. Belt and Pulley (If applicable) | 1 no. of each type |
| | 5. Gear Box Assembly (If Applicable) | 1 no. of each type |
| | 6. Agitator shaft assembly | 1 no. of each type and size |
| | 7. Complete Agitator assembly | 1 no. of each type and size |
| **1.07.00** | **Slurry Pumps**<br>(Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump, Gypsum Bleed Pumps, Mill Circuit Pump, Limestone slurry supply Pumps and any other slurry pumps) | |
| | 1. Impeller Assembly | 4 no. of each type and size |
| | 2. Complete Casing (For the Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump Bidder shall supply complete casing) | 1 no. of each type and size |

| | | |
|---|---|---|
| | 3. Casing Liners (where replaceable liners are provided) | 1 set* |
| | 4. Seals | 4 set of each type and size |
| | 5. Bearings | 1 no. of each type and size |
| | 6. Motor | 1 no. of each type and size |
| | 7. GEAR BOX | 1 No. for each type and size of pump. |
| | 8. Motor-Pump Coupling | 1 no. of each type |
| **1.08.00** | **Hydro-cyclones**<br>(Mill , Gypsum Primary Dewatering, Secondary Waste Water and any other Hydrocyclone) | |
| | 1. Hydro-cyclone Isolation Valve | 10% of each type OR 1 no. whichever is higher |
| | 2. Hydro-Cyclone | 10% of each type OR 1 no. whichever is higher |
| | 3. Hydro-Cyclone rubber lining-Feed chamber and Overflow chamber | 10% of each type OR 1 no. whichever is higher |
| | 4. Vortex finder & Apex inserts | 10% of each type OR 1 no. whichever is higher |
| **1.09.00** | **Feeders** | |
| | 1. Belt | 2 sets * |
| | 2. Belt drive motor | 1 nos. |
| | 3. Belt drive reducer | 1 nos. |
| | 4. Speed Reducer Assembly | 1 set* |
| | 5. Weighing Instruments | 1 set* |
| | 6. Feeder weighing roll | 1 no. |
| | 7. Gravimetric feeder gate actuator | 1 no. |

| | | |
|---|---|---|
| | assembly | |
| | 8. Counter assembly of feeder complete | 1 no. |
| | 9. Feeder head pulley assembly | 1 no. |
| **1.10.00** | **Limestone Mills** | |
| | 1. Mill Wear Parts (Liners) & Grinding element | 1 sets |
| | **Note :** One set of Mill Wear Parts (Liners) above is defined as under :<br>1 Set = (Grinding elements needed for complete replacement of one mill) X (8000 x 1) / GWL, rounded off to nearest higher whole number.<br>Where :<br>GWL =Guaranteed wear life of Mill Wear Parts as offered by the bidder. | |
| | 2. Mill Motor | 1 no. |
| | 3. Auxiliary Motor | 1 no. |
| | 4. Gear box internals (including Bearings and Seals) | 2 sets * |
| | 5. Complete Gear Box | 1 sets * |
| | 6. Mill motor Bearings | 1 sets * |
| | 7. Lube Oil / Grease System | |
| | 7.1 Pump assembly | 1 nos. of each type |
| | 7.2 Motor | 1 nos. of each type |
| | 7.3 Pressure regulator | 1 nos. of each type |
| | 7.4 Filters | 2 nos. of each type |
| | 7.5 Pump & Motor coupling | 1 nos. of each type |

| | | |
|---|---|---|
| **1.11.00** | **Slurry Valves** | 4 no. of each type and size |
| **1.12.00** | **Slurry Line Bends** | 4 no. of each type and size |
| **1.13.00** | **Vacuum Belt Filter** | |
| | 1. Filter Cloth | 4 sets |
| | 2. Belt | 1 sets |
| | 3. Vacuum Box Seals | 2 sets |
| | 4. Drive Motor | 1 no. |
| **1.14.00** | **Vacuum Pumps** | |
| | 1. Pump Impeller Assembly | 1 no. |
| | 2. Pump Bearing | 1 set |
| | 3. Seals | 1 set |
| | 4. Motor | 1 no. |
| **1.15.00** | **Vacuum Breaker Valves** | |
| | 1. Valve Assembly | 1 no. |
| | 2. Actuator | 1 no. |
| **1.16.00** | **Sump Pumps** | |
| | 1. Complete Impeller Assembly | 1 no. of each type |
| | 2. Casing Liners | 1 set* of each type |
| | 3. Bearing | 1 set* |
| | 4. Motor | 4 no. of each type |
| | 5. Pump discharge valve assembly | 1 no. of each type |
| **1.17.00** | **Horizontal Centrifugal Pumps** | |
| | 1. Complete Impeller Assembly | 1 no. of each type |

| | | |
|---|---|---|
| | 2. Casing Liners | 1 set* of each type |
| | 3. Bearing | 1 set* |
| | 4. Motor | 1 no. of each type |
| | 5. Pump discharge valve assembly | 1 no. of each type |

Note:

1. Any change in size, material, design etc, which obviates one to one replacement of the part shall be considered a different type.

* Unless otherwise stated, a set shall mean complete replacement for one equipment.

| **1.18.00** | **Goods Cum Passenger Elevator** | |
|---|---|---|
| | 1. Friction block | 2 nos. |
| | 2. Guide roller of each type | 20% of total population or 3 nos. of type whichever is higher |
| | 3. Contactors of each type | 2 nos. |
| | 4 Control Transformer | 1 no. of each type |
| | 5. Time device | 2 nos. of each type |
| | 6. Rectifiers | 4 nos. of each type |
| | 7. Overcurrent relay | 2 nos. of each type |
| | 8. Auxiliary relay | 3 nos. of each type |
| | 9. Resistor | 3 nos. of each type |
| | 10. Fuses of each rating | 20% of the total population |
| | 11. Limit switches of each type | 3 nos. |
| | 12. Push button | 3 nos. of each type |

| | | |
|---|---|---|
| | 13. Contact device (if applicable) | 3 nos. of each type |
| | 14. Brake motor | 2 nos. of each type |
| | 15. Transmitters | 2 nos. of each type |
| | 16. Switches of each type | 3 nos. |
| | 17. Receiver | 2 nos. of each type |
| | 18. Bearings of each type & size | 2 nos. |
| | 19. Roller of each type | 3 nos. |
| | 20. Worm gear spares | |
| | 'O' rings | 3 sets * |
| | Sealing ring of each type | 3 sets * |
| | 21. Spares for brake | |
| | Fan | 2 nos. of each type |
| | Magnetic coil | 3 nos. of each type |
| | Brake disc | 2 sets * |
| | Brake pad | 2 sets * |
| | 22. Bushing (for door front) | 2 sets * |
| | 23. Pinion | 2 nos. of each type |
| | 24. Elevator Motor with VVVF drive | 1 no of each type |

**1.19.00 AIR CONDITINING AND VENTIALTION SYSTEM**

| | | |
|---|---|---|
| 1.0 | **Air handling unit (for each model)** | |
| 1.1 | V-belts for AHU Blower | 2 Sets |

| | | |
|---|---|---|
| 1.2 | AHU Blower bearing | 1 Set |
| 1.3 | Blower motor bearing | 1 Set |
| 1.4 | Filters at suction and discharge of all AHUs | 25% of installed population |
| 2.0 | **Unitary air filtration unit** | |
| 2.1 | *Supply Air fans* | |
| 2.1.1 | V-belts for supply air fans | 2 Sets |
| 2.1.2 | Supply air fan bearings | 1 Set |
| 2.2 | *UAF Pump* | |
| 2.2.1 | Pump bearings | 1 Set |
| 2.2.2 | Impeller for pump | 1 no. |
| 2.2.3 | Pump Shaft | 1 no. |
| 2.2.4 | Shaft sleeves | 1 Set |
| 2.2.5 | Gland Packings for pumps | 1 Set |
| 2.2.6 | Nylon Filter | 1 Set |
| 2.2.7 | Spray nozzles | 5% of total population or 50 Numbers whichever is higher. |
| 2.2.8 | Water strainer | 1 No. |
| 2.2.9 | Brass suction screen/strainer for unitary air filtration tank. | 1 Set |
| 2.2.10 | Motor for Centrifugal fan for UAF | 1 No |
| **3.0** | **Control & Instrumentation** | |
| i) | Air-Conditioning System | |

| CLAUSE NO. | MANDATORY SPARES | |
|---|---|---|

| | | |
|---|---|---|
| 3.1 | Electronic Transmitters | |
| 3.1.1 | Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.) | 5% or 1 No. of each type and model whichever is more. (to be divided into various ranges in proportion to main population) |
| 3.2 | Temperature elements | |
| 3.2.1 | RTD's* | 5% or 1 No. which ever is more ** |
| 3.2.2 | Thermo well<br>* (With head assembly, terminal block and nipple) | 5% or 1 No. which ever is more **<br>** (to be divided into various insertion lengths in proportion to main population) |
| 3.3 | All types of Local Indicators | 5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main population of all make, model and type) |
| 3.4 | Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, and | 5% or 1No. of each type and |

| | | |
|---|---|---|
| | differential temperature, level switch Devices. | model whichever is more. |
| 3.5 | Relative Humidity Sensors | 1 No. |
| 3.6 | Geyserstat | 1 No. |
| 3.7 | Local Humidity/Temperature indicators | 2 Nos. each |
| 4.0 | **Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)** | |
| 4.1 | Valves | 10% or 1 No. of each type, class, size and model whichever is more. |
| 4.2 | 2 way, 3way, 5way valve manifolds | 10% or 1 No. of each type, class, size and model whichever is more. |
| 4.3 | Fittings | 10% or 1 No. of each type, class, size and model whichever is more. |
| (II) | Ventilation System | |
| **5.0** | **Measuring Instruments** | |
| 5.1 | Pressure Gauge | 1 No. (for centrifugal pumps of UAF units). |
| 5.2 | Level transmitter | 1 No. |
| 5.3 | Pressure transmitter | 1 No. (for UAF units) |

| | | |
|---|---|---|
| 6.0 | **Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)** | |
| 6.1 | Valves | 1 no. of each type, class, size and model |
| 6.2 | 2 way valve manifold | 1 no. of each type, class, size and model |
| 6.3 | Fittings | 1 no. of each type, class, size and model |

**1.20.00 SPARES FOR FGD WASTE WATER TREATMENT (FGD WWT) SYSTEM FOR ZLD (APPLICABLE FOR PROJECTS WHERE ZLD SYTEM IS BEING PROVIDED)**

| **A-1) Blowers (If applicable) (FOR EACH TYPE & SIZE)** | | | |
|---|---|---|---|
| **Sl. No.** | **Name of Items** | **Unit** | **QTY** |
| | | | |
| 1) | Impeller with nuts & other accessories | Set | 1 |
| 2) | Shaft | Set | 1 |
| 3) | Bearings of Blowers | Set | 1 |
| 4) | Suction filter Assembly | Set | 1 |
| 5) | V Belts (if applicable) | Set | 1 |
| **Note : One(1) set consists of quantity required for complete replacement for one(1) blower** | | | |
| **A-2) Flushing/Cleaning System (if applicable) (FOR EACH TYPE & SIZE)** | | | |
| **Sl. No.** | **Name of Items** | **Unit** | **QTY** |
| 1) | Flushing Pump | No | 1 |
| **A-3) Chemical Cleaning System (If applicable ) (FOR EACH TYPE & SIZE)** | | | |
| **Sl. No.** | **Name of Items** | **Unit** | **QTY** |
| 1) | Mixer (Agitator) of Chemical Tanks | No | 1 |
| 2) | Chemical Cleaning Pump | No | 1 |
| 3) | Cartridge Filter Elements (If applicable) | Set | 1 |

**a- 4) Spares for horizontal pumps for FGD WWT system for ZLD (for each type & size)**

| Sl. No. | Name of Items | Unit | QTY |
|---|---|---|---|
| 1) | Impeller with nuts & other accessories | Set | 1 |
| 2) | Wearing rings (Impeller & Casing ; as applicable) | Set | 2 |
| 3) | Shaft | Set | 1 |
| 4) | Shaft Sleeves | Set | 2 |
| 5) | Pump & Drive Coupling, bushes, pins with all fasteners | Set | 1 |
| 6) | Pump bearings | Set | 1 |
| 7) | Mechanical Seal (if applicable) | Set | 1 |

**Note : One(1) set consists of quantity required for complete replacement for one(1) Pump of each type/size**

**A-5) Spares for Clarifier**

| Sl. No. | Name of Items | Unit | Qty |
|---|---|---|---|
| 1) | Turbine drive shaft assembly (If applicable) | Set | 1 |
| 2) | Rake (Scrapper) drive shaft assembly (If applicable) | Set | 1 |
| 3) | Oil seal for gear box | Set | 1 |

**Note: One (1) set consists of quantity required for complete replacement for one clarifier.**

**A- 6) Spares for Injection/dosing pumps in Chemical storage & dosing system (for each type & size)**

| Sl. No. | Name of Items | Unit | QUANTITY |
|---|---|---|---|
| **1)** | Complete Pump | **Set** | **1** |

**A- 7) Spares for Unloading pumps in Chemical storage & dosing system (for each type & size)**

| Sl. No. | Name of Items | Unit | QTY. |
|---|---|---|---|
| 1) | Complete Pump | Set | 1 |

**a-8) Spares for Agitators (for each type & size)**

| Name of Items | Unit | QTY |
|---|---|---|
| Agitator Assembly with Motor & Gear Box | Set | 1 |

**A- 9) Valves (except Control Valves)**

| Sl. No. | Name of Items | Unit | QTY |
|---|---|---|---|
| 1) | Valves of all types | LOT | 1 numbers of each type / size /material of construction/Rating |

| A- 10) Spares for Electrically operated hoist for FGD WWT system for ZLD (for each type & size) | | | |
|---|---|---|---|
| **Sl. No.** | **Name of Items** | **Unit** | **QTY.** |
| 1) | Bearings | Set | 1 |
| 2) | Rope guide | Set | 1 |
| 3) | Brake lining | Set | 1 |
| 4) | Wire rope | Set | 1 |
| **Note : One(1) set consists of quantity required for complete replacement for one(1) hoist of each type & capacity** | | | |

| A- 11) Spares for Plate type heat exchangers for FGD WWT system for ZLD (for each type & size) | | | |
|---|---|---|---|
| **Sl. No.** | **Name of Items** | **Unit** | **QTY.** |
| 1) | Gaskets | Lot | comprising 30% of total requirement |
| 2) | Fastners | Lot | comprising 10% each type |
| 3) | Plates | Lot | comprising 20% of each type |
| **Note : One(1) set consists of quantity required for complete replacement for one(1) heat exchanger of each type & capacity** | | | |

| A- 12) Spares for Vapor Compressors for FGD WWT system for ZLD (for each type & size) | | | |
|---|---|---|---|
| **Sl. No.** | **Name of Items** | **Unit** | **QTY.** |
| 1) | Impeller Assembly | Set | 1 |
| 2) | Bearings | Set | 1 |
| **Note : One(1) set consists of quantity required for complete replacement for one(1) compressor of each type & capacity** | | | |

**1.21.00** **AIR CONDITINING AND VENTIALTION SYSTEM**

| | | |
|---|---|---|
| 1.0 | **Air handling unit (for each model)** | |
| 1.1 | V-belts for AHU Blower | 2 Sets |
| 1.2 | AHU Blower bearing | 1 Set |
| 1.3 | Blower motor bearing | 1 Set |
| 1.4 | Filters at suction and discharge of all AHUs | 25% of installed population |

| | | |
|---|---|---|
| 2.0 | **Unitary air filtration unit** | |
| 2.1 | *Supply Air fans* | |
| 2.1.1 | V-belts for supply air fans | 2 Sets |
| 2.1.2 | Supply air fan bearings | 1 Set |
| 2.2 | *UAF Pump* | |
| 2.2.1 | Pump bearings | 1 Set |
| 2.2.2 | Impeller for pump | 1 no. |
| 2.2.3 | Pump Shaft | 1 no. |
| 2.2.4 | Shaft sleeves | 1 Set |
| 2.2.5 | Gland Packings for pumps | 1 Set |
| 2.2.6 | Nylon Filter | 1 Set |
| 2.2.7 | Spray nozzles | 5% of total population or 50 Numbers whichever is higher. |
| 2.2.8 | Water strainer | 1 No. |
| 2.2.9 | Brass suction screen/strainer for unitary air filtration tank. | 1 Set |
| 2.2.10 | Motor for Centrifugal fan for UAF | 1 No |
| **3.0** | **Control & Instrumentation** | |
| i) | Air-Conditioning System | |
| 3.1 | Electronic Transmitters | |
| 3.1.1 | Transmitters of all types and model no. (for the measurement of Pressure, differential pressure flow, level, temperature etc.) | 5% or 1 No. of each type and model whichever is more. (to be divided into various ranges in proportion to main population) |

| | | |
|---|---|---|
| 3.2 | Temperature elements | |
| 3.2.1 | RTD's* | 5% or 1 No. which ever is more ** |
| 3.2.2 | Thermo well<br>* (With head assembly, terminal block and nipple) | 5% or 1 No. which ever is more **<br>** (to be divided into various insertion lengths in proportion to main population) |
| 3.3 | All types of Local Indicators | 5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main population of all make, model and type) |
| 3.4 | Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, and temperature, and differential temperature, level switch Devices. | 5% or 1No. of each type and model whichever is more. |
| 3.5 | Relative Humidity Sensors | 1 No. |
| 3.6 | Geyserstat | 1 No. |
| 3.7 | Local Humidity/Temperature indicators | 2 Nos. each |
| 4.0 | **Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)** | |
| 4.1 | Valves | 10% or 1 No. of each type, class, size and model whichever is more. |
| 4.2 | 2 way, 3way, 5way valve manifolds | 10% or 1 No. of each type, class, size and model whichever is more. |
| 4.3 | Fittings | 10% or 1 No. of each type, class, size and model whichever is more. |

| | | |
|---|---|---|
| (II) | Ventilation System | |
| **5.0** | **Measuring Instruments** | |
| 5.1 | Pressure Gauge | 1 No. (for centrifugal pumps of UAF units). |
| 5.2 | Level transmitter | 1 No. |
| 5.3 | Pressure transmitter | 1 No. (for UAF units) |
| 6.0 | **Process Connection Piping (for Impulse Piping / Tubing, Sampling Piping / Tubing and Air Supply Piping as Applicable)** | |
| 6.1 | Valves | 1 no. of each type, class, size and model |
| 6.2 | 2 way valve manifold | 1 no. of each type, class, size and model |
| 6.3 | Fittings | 1 no. of each type, class, size and model |
| | | |

**1.22.00 FIRE DETECTION AND PROTECTION SYSTEM**

| | **ITEM DESCRIPTION** | **QUANTITY** |
|---|---|---|
| **1.0** | **DELUGE VALVE ASSEMBLIES** | |
| 1.1 | Complete deluge valve assembly along with internals and accessories | |
| 1.1.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 1.1.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 1.1.3 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| 1.2 | Clapper assembly complete (consisting of clapper seat rubber, screws, etc.) | |
| 1.2.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 1.2.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 1.2.3 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 1.3 | Solenoid coils | |
| 1.3.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 1.3.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 1.3.3 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| **2.0** | **VALVES (BUTTERFLY)** | |
| 2.1 | Butterfly | |
| 2.1.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.1.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.1.2 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.2 | Disc (Butterfly) | |
| 2.2.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.2.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.2.3 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| 2.3 | Stem for Butterfly Valve | |
| 2.3.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.3.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.3.3 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| **2.4** | **Gasket for Butterfly Valve** | |
| 2.4.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.4.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.4.2 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| **2.5** | **Bushing/Bearing (butterfly valve)** | |
| 2.5.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.5.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 2.5.3 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| **3.0** | **BASKET STRAINERS / Y-TYPE STRAINERS for HVW / MVW SPRAY SYSTEM** | |
| 3.1 | Strainer elements with o-rings and stiffeners. | |
| 3.1.1 | Y- Type strainer | |
| 3.1.1.1 | 150 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| 3.1.1.2 | 100 NB | 10% or 1 No. of each type, class, size and model whichever is more. |

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| 3.1.1.3 | 80 NB | 10% or 1 No. of each type, class, size and model whichever is more. |
| **4.0** | **MVW SPRAY SYSTEM** | |
| 4.1 | Spray Nozzles | 10% or 10 No. of each type, class, size and model whichever is more. |
| 4.2 | QB Detectors | 10% or 20 No. of each type, class, size and model whichever is more. |
| **5.0** | **HVW SPRAY SYSTEM** | |
| 5.1 | Spray nozzles | 10% or 10 No. of each type, class, size and model whichever is more. |
| 5.2 | QB Detectors | 10% or 20 No. of each type, class, size and model whichever is more. |
| **6.0** | **FIRE DETECTORS** | |
| 6.1 | Multisensor detectors (Addressable) | 10% or 10 No. of each type, class, size and model whichever is more. |
| 6.2 | Indicators assembly for smoke detectors provided in false ceiling (Response indicator) | 10% or 10 No. of each type, class, size and model whichever is more. |
| 6.3 | LHS cable for conveyors | 10% of each type, class, size and model whichever is more. |
| **7.0** | **CONTROL AND INSTRUMENTATION** | |
| **7.1** | **MEASURING INSTRUMENTS** | |
| 7.1.1 | All types of Local indicators | 1 no. of each make, model and type |
| 7.1.2 | Process Actuated Switch Devices :<br>(All types of Pressure, diff. pressure, flow, temperature, level switch devices). | 1 no. of each type and model |

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| 7.1.3 | All type of Electronic Transmitters and Ultrasonic Transmitters including sensors. | 10% or 1 no. of each type and model whichever is more. |
| 7.1.4 | Limit switches for isolation valves | 1 no. of each type |
| **7.2** | **PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)** | |
| 7.2.1 | Valves | 1 no. of each type, class, size and model. |
| 7.2.2 | 2 way, 3 way, 5 way valve manifolds | 1 no. of each type, class, size and model. |
| 7.2.3 | Fittings | 5% or 1 no. of each type, class, size and model whichever is more. |
| **7.3** | **CABLES** | |
| 7.3.1 | Pre fabricated cable of each type. | 1 no. of each type, size and model. |
| 7.3.2 | Pre fabricated cable connector | 1 no. of each type and model |
| 7.3.3 | Other cables (including core cable, short term fire proof cable, fibre optic cables etc) | 5% of each type, pair/ core and size of actual installed quantity. |
| **7.4** | **FIRE ALARM PANEL & REPEATER FIRE ALARM PANEL** | |
| 7.4.1 | Fuses | 100% of population |
| 7.4.2 | Indicating lamps | 100% of population |
| 7.4.3 | Push Button | 10 Nos. of each type and rating |
| 7.4.4 | Power supply modules | 10% or 1 No. of each type & rating whichever is more |
| 7.4.5 | Control modules, loop cards modules, isolator cards | 10% or 1 No. of each type, whichever is more. |

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| 7.4.6 | LCD display of each type unit of panel | 1 No. |
| 7.4.7 | Cartridges for printers | 2 Nos. |
| 7.4.8 | Interface unit / modules for non-addressable devices, auxiliary / output relay modules, control modules, supervisory control modules and any other electronic modules | 10% or 1 No. of each type whichever is more. |
| 7.4.9 | LED's of each type | 100% of population. |
| 7.4.10 | Power supervision relay | 4 Nos. of each type. |
| 7.4.11 | Fire screen / alarm buzzer | 1 No. of each type |

**1.23.00** **Compressed Air System:**

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| 1.0 | Oil free Screw Air Compressor | |
| 1.1 | H. P. Stage<br>Complete HP Stage assembly consisting of high pressure element, Bearing for male and female rotors (drive end), Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts. | 1 Set of each type/rating |
| 1.2 | L. P. Stage<br>Complete LP Stage assembly consisting of | 1 Set of each type/rating |

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| | high pressure element, Bearing for male and female rotors (drive end),Bearing for male and female rotors (non-drive end), Timing gears, Graphite ring shaft for compressor chamber seals or white metal labyrinth, suction valve, discharge valve, packing set, Axial thrust bearing, Labyrinth oil seal or radial seals or double acting seals for drive shafts. | |
| 1.3 | Motor Bearings | 2 Sets |
| 1.4 | LP stage Gear and Pinion | 1 Set |
| 1.5 | HP stage Gear and Pinion | 1 Set |
| 1.6 | Air Intake Filter Element With Gaskets | 4 Sets |
| 1.7 | Oil Filter Element With Gaskets & Seals | 4 Sets |
| 1.8 | Safety Valve Springs and Gaskets for HP stage | 1 Set |
| 1.9 | Safety Valve Springs and Gaskets for LP stage | 1 Set |
| 1.10 | Valves (within the compressor house with actuators | 2 nos of each type/ratings/ size. |
| 1.11 | Oil Pump/Motor | |
| 1.11.1 | Oil Pump and Motor complete assembly | 1 Set |
| 1.11.2 | Pump impeller/rotor with shaft | 1 Set |
| 1.11.3 | Set of bearings | 2 Set |
| 1.11.4 | Set of Seals | 2 Set |
| 1.12 | Drain / Moisture Trap | 2 Set of each type/size. |
| 1.13 | Oil Cooler Gaskets & Seals | 2 sets |

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| 2.0 | **AIR DRYING PLANT (Twin tower type) FOR IA SYSTEM (As applicable)** | |
| 2.1 | Pre filter element(Ceramic candle or as applicable) | 2 sets |
| 2.2 | After filter element(Ceramic candle or as applicable) | 2 sets |
| 2.3 | Heater element(if applicable) | 1 sets |
| 2.4 | Blower bearing(if applicable) | 1 sets |
| 2.5 | Blower motor bearing(if applicable) | 2 sets |
| 2.6 | Valves & Valve Actuators (pneumatic/hydraulic) | 2 sets |
| 2.7 | Heater coil for temperature stabilization (for HOC type)(as applicable) | 2 sets |
| 3.3 | Rotary drum type Air drying plant for Instrument Air system (As applicable) | |
| 3.3.1 | Drive assembly consisting of motor, gear boxes, drive shaft & coupling | 1 set |
| 3.4 | Motor for air compressor | 1 no. |
| 3.5 | **MEASURING INSTRUMENTS** | |
| | **1 Electronic Transmitters** | |
| | (i) Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.) | 10% or 1 No. of each type and model, whichever is more |
| | **2 Temperature elements** | |
| | (i) RTD's* of each type and length | 10% or 2 Nos. of each type and length Which ever is more |
| | ii) Thermocouples of each type like K-type, R-type, metal etc. and length * | 10% or 2 Nos. of each type and length Which ever is |

| | ITEM DESCRIPTION | QUANTITY |
|---|---|---|
| | | more |
| | (iii) Thermowell for application like mill outlet temperature and SH/RH/Eco/ true gas temp. in furnace | 10% or 2 Nos. of each type and length Which ever is more |
| | (iv) Temperature transmitters | 10% of each type and length whichever is more |
| | 3 Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges flow meters etc., | 5% or 1 No. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make, |
| | 4 Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices | 5% or 1 No. of each type and model whichever is more |
| | 5 Dew Point meters | 5% or 1 No. of each type and model whichever is more |
| **3.6** | **MICROPROCESSOR BASED/PLC BASED CONTROL/ ELECTRONIC BASED CONTRAL PANEL (IF APPLICABLE)** | |
| 1 | Fully programmed controller of electronic modules of each type (as applicable) | 10% or 1 no. whichever is more |
| 2 | Power supply module (if applicable) | 10% or 1 no. whichever is more |

| **NOTE:** | |
|---|---|
| 1. | Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment. |
| 2. | Any fraction of a item shall mean the next higher integer. |

| | |
|---|---|
| 3. | Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number. |
| 4. | Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid. |
| 5. | In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list. |

**1.24.00 LIMESTONE & GYPSUM HANDLING**

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| **1** | | | **Mechanical** | | |
| **A)** | | | **Paddle Feeder** | | |
| 1 | | | Rotor arm with Liners & Bolts | 1 | sets of each type |
| 2 | | | Liners of rotor arms | 2 | sets of each type |
| 3 | | | Gear box (including Paddle wheel, | | |
| | | | Travel drive, cable reel drive ) | | |
| | i) | | Complete assembly | 1 | set of each type |
| | ii | | Bearings | 1 | set of each type |
| | iii) | | Oil Seals | 2 | nos. of each size |
| | iv) | | Input shaft with pinion | 2 | sets of each type |
| 4 | | | **Hydraulic Power Pack** | | |
| | i) | | Rotor Pump with electric motor, coupling, valves & servo motor (mounted on pump)etc. | 2 | set of each type and rating |
| | ii) | | Solenoid Valves complete with coils | 2 | set of each type and size |

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | iii) | | Filter element (1 No. Pressure Filter + 1 No. Return Filter) | 10 | sets of each type |
| | iv) | | Hydraulic Hoses | 4 | sets |
| | v) | | Hydraulic Motor (for Paddle wheel) | 2 | nos of each type |
| | vi) | | Hydraulic Motor (for Traverse Drive) | 2 | nos of each type |
| | vii) | | Traverse pump with electric motor, coupling, valves (mounted on pump) & servo motor (mounted on pump)etc. | 2 | sets of each type |
| | viii) | | Dust suppression pump and motor assembly | 1 | nos of each type |
| | ix) | | Spray nozzles of dust suppression system | 10 | nos of each type |
| | x) | | Cooler | 1 | nos of each type |
| 5 | | | **Carriage wheel assembly** | | |
| | i) | | Bearings | 2 | nos. of each type & size |
| | ii) | | Plummer Block | 2 | nos. of each type & size |
| | iii) | | Oil seals | 2 | nos. of each type & size |
| | iv) | | Carriage wheel with shaft (without plummer blocks) | 1 | sets |
| | v) | | Traverse drive assy including electric motor, gear box, coupling etc. Or Geared Motor as applicable | 1 | set |
| | vi) | | Tension roller of paddle feeder trolley | 1 | set |
| 6 | i) | | All type of coupling (including those between electric motor and pump, between hydraulic motor and gear box and between gear box and paddle wheel & between carriage wheel and motor) | 2 | nos. of each type |

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## MANDATORY SPARES

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | ii) | | Coupling bolt with bushes / spider /inserts | 2 | sets of each size |
| | iii) | | Rubber bush / spider / inserts | 8 | sets of each size |
| 7 | i) | | Brakes (if any) | 2 | sets of each type & size |
| | ii) | | Brake shoe | 4 | sets of each type & size |
| 8 | | | **Cable reel drive** | | |
| | i) | | Complete drive unit assembly including motor, gear box, coupling etc. | 1 | sets of each type & rating |
| | ii) | | Chain | 2 | nos. |
| | iii) | | Plummer Block and bearings for cable reel drum | 1 | sets |
| | iv) | | Cable guide assembly | 1 | set |
| | vii) | | Torque regulator unit | 1 | set |
| | viii) | | Friction pads | 2 | set |
| | ix) | | Spring stacks | 2 | set |
| | x) | | Oil seals | 4 | sets |
| | xi) | | Eddy current/magnetic coupling | 1 | set of each type & rating |
| | xii) | | Spare Festoon hanger cum roller assembly(below CRD) | 10 | nos. |
| | xiii) | | Spare energy chain links | 5% | of population |
| **B)** | | | **IDLERS** | | |
| 1 | i) | | $35^{o}$ Troughing idlers complete with base frame and mounting brackets etc. | 2.5% | of population of each type |
| | ii) | | Rolls for (i) above | 1% | of population of each type |
| 2 | i) | | Troughing idlers complete with base frame & mounting brackets ctc.(for belt feeder). | 30% | of population of each type |
| | ii) | | Rolls for (i) above | 30% | of population of each type |

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## MANDATORY SPARES

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| 3 | i) | | $35^0$ impact idlers complete with mounting brackets and base frame etc. | 25% | of population of each type |
| | ii) | | Rolls for (i) above | 25% | of population of each type |
| 4 | | | $35^0$ troughing training idler complete with base frame and brackets etc. (if used) | 10% | of population of each type |
| 5 | | | Transition idler complete as in (1) above | 10% | of population of each type |
| 6 | | | Flat return idlers complete with mounting brackets etc. | 2% | of population of each type |
| 7 | | | Flat return idlers complete with mounting brackets etc.(for belt feeders) | 30% | of population of each type |
| 8 | | | Flat return trainer complete with mounting brackets etc. | 10% | of population of each type |
| 9 | | | Belt cleaning spiral rubber disc return idler complete with mounting brackets etc. | 20% | of population of each type |
| 10 | i) | | Two roll $10^o$ troughing return idler assy | 2% | of population of each type |
| | ii) | | Rolls for (I) above | 2% | of population of each type |
| 11 | | | SS idlers | 25% | of population of each type |
| 12 | | | Any other type of idlers | 10% | of population of each type |
| **C)** | | | **CONVEYOR GEAR BOXES** | | |
| | i) | | Input shafts with pinion | 1 | set of each type and rating |
| | ii) | | Oil seals | 2 | sets of each type and rating |
| | iii) | | Bearings | 1 | set of each type and rating |
| | iv) | | Hold back device | 2 | nos. of each type and rating |
| | v) | | Cooling fan with cover | 2 | nos.of each type and rating |
| | vi) | | Complete gear box assy with hold back device | 1 | set of each type and rating for population upto 10 nos. |

CLAUSE NO.

## MANDATORY SPARES

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | | | | 2 | set of each type and rating for population more than 10 nos. |
| **D)** | | | **CONVEYOR DRIVE AND CONVEYOR BELT** | | |
| **a)** | | | **Gear Coupling** | | |
| | i) | | All type of drive couplings including gear Coupling | 2 | nos. of each type |
| | ii) | | Bolts for gear coupling | 2 | sets of each size |
| | iii) | | Seal kit for gear coupling (o-ring) | 2 | sets of each type |
| **b)** | | | **Fluid Coupling** | | |
| | i) | | Fluid Coupling complete | 1 | no. of each type and size |
| | ii) | | Multi Disc assembly (for fluid coupling) | 4 | nos each type and size |
| | iii) | | Resilient Drive plate assy. | 1 | no. of each type and size |
| | iv) | | Bearings | 1 | no. of each type and size |
| | v) | | Seal kit for fluid coupling | 2 | sets of each size |
| | vi) | | Fusible plug | 10 | nos. of each size |
| | vii) | | Complete actuator and engaging assembly (including motor, gear box etc.) | 1 | set of each type |
| | viii) | | Oil Cooler assembly (if applicable) | 1 | set of each type |
| | ix) | | Oil pump-motor set (if applicable) | 1 | set of each type |
| | x) | | Oil filters | 5 | sets of each type |
| | xi) | | Oil/Cooler valves (if applicable) | 2 | nos. of each type |
| **c)** | | | **Belting** | | |
| | | | **Conveyor Belt** | | |
| | i) | | Main Conveyors | 2 | drum length of 250 m of each type, size and |

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | | | | | rating if total population of particular type, size and rating of conveyor is equal to or more than 2500 m |
| | | | | 1 | drum length of 250 m of each type, size and rating if total population of particular type, size and rating of conveyor is less than 2500 m |
| | ii) | | Belt feeder & bunker seal belt, as applicable | one | complete length of each type |
| **d)** | | | **Brakes** | | |
| | i) | | Brakes | 1 | no of each size & type |
| | ii) | | Brake shoes | 2 | sets of each size |
| **E)** | | | **PULLEYS** | | |
| | i) | | Pulleys complete with shaft excluding bearing & plummer blocks (complete with lagging) | 1 | no. of each type and size in pulley drum and shaft dia.(for population upto 10 Nos) |
| | | | | 2 | no. of each type and size in pulley drum and shaft dia.(for population more than 10 Nos) |
| | ii) | | Plummer Block complete with bearings & sleeves | 2 | no. each type and size |

| CLAUSE NO. | MANDATORY SPARES | |
|---|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | iii) | | SS Pulleys complete with shaft excluding bearing & plummer blocks (complete with lagging) | 1 | no. of each type and size in pulley drum and shaft dia. |
| **F)** | | | **BELT CLEANERS AND SKIRT BOARD** | | |
| | i) | | Modular segments for belt cleaner | 5 | %of total population of each type & size |
| | ii) | | Modular segments skirt rubber for skirt board | 5 | %of total population of each type & size |
| | iiI) | | Skirt Rubber | 5 | %of total population of each type & size |
| | iv) | | Complete belt cleaner (internal / external ) | 2 | %of total population of each type & size |
| **G)** | | | **IN-LINE MAGNETIC SEPARATORS** | | |
| | i) | | Cleated conveyor belt | 1 | set |
| | ii) | | Motor, gear box drive assy. complete | 1 | set |
| | iii) | | Pulleys with plummer block & bearings | 1 | set of each size & type |
| | iv) | | Sheaves | 1 | no. of each size & type |
| | v) | | V-belts | 2 | no. of each size & type |
| **H)** | | | **LIME SAMPLER** | | |
| | i) | | Plummer block | 1 | no. of each type and size |
| | ii) | | Hammers | 1 | set of each type and size |
| | iii) | | Liner plate | 1 | set |
| | iv) | | Cutter lip | 1 | no. |
| | v) | | Cutter seal | 1 | no. |
| | vi) | | V-belts (for crusher) | 1 | sets |
| | vii) | | Hammer pins | 1 | sets of each |

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | | | | | type and size |
| | viii) | | Pulley | 1 | no. of each type and size |
| | ix) | | Conveyor belt | 1.2 | times length of each type and rating |
| | x) | | Gear box assembly for conveyor | 1 | no. of each type and rating |
| | xi) | | Gear box drive assy, for primary and secondary samplers | 1 | set of each type and rating |
| | xii) | | Hydraulic pump with motor and coupling | 1 | set of each type |
| | xiii) | | Hydraulic motor | 1 | set of each type |
| | xiv) | | Hydraulic cylinder | 1 | set of each type |
| | xv) | | Cylinder sealing kit | 2 | set of each type |
| | xvi) | | Set of hoses | 2 | set of each type |
| | xvii) | | Coupling with grid for primary sampler | 2 | sets |
| | xviii) | | Screw conveyor gear box assembly | 1 | set |
| **I)** | | | **LIME CRUSHER** | | |
| | i) | | Plummer Block assembly complete including bearing, lock nut, lock washer etc.(DE+NDE) | 2 | set |
| | ii) | | Shaft seal | 4 | sets |
| | iii) | | Hammer sets | 10 | sets or 750 Nos whichever is more (1 set means hammers required for one crusher) |
| | iv) | | Rotor assembly complete consisting of rotor shaft & keys, End discs, Centre discs, distance rings, suspension bars, disc clamping nuts and shaft extension etc. but without hammers, bearings and pillow | 1 | set |

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | | | blocks | | |
| | v) | | Cage bars/Perforated screen plates as applicable | 4 | sets |
| | vi) | | Breaker plate | 4 | sets |
| | vii) | | Liners | 2 | sets |
| | viii) | | Suspension bars | 4 | set |
| | ix) | | Kick-off plate | 4 | set |
| | x) | | Screen plate upper & lower | 4 | no. each |
| | xi) | | Tramp iron pick up plate | 2 | no. each |
| | xii) | | Fluid coupling | | |
| | a) | | Fluid coupling complete | 1 | set |
| | b) | | Bearings | 2 | set |
| | c) | | Seal kit (sealing rings) | 2 | sets |
| | d) | | Fusible plugs | 8 | nos. |
| | e) | | Oil pump motor set (if applicable) | 1 | set of each type |
| | f) | | Oil filter | 3 | sets |
| | g) | | Complete actuator and engaging assembly (including motor, gear box etc.) | 1 | set |
| | h) | | Cooler assembly (if applicable) | 1 | no. |
| | i) | | Oil / Water valves | 2 | nos. of each type |
| | j) | | Gear Coupling/ other flexible coupling of crusher drive along with bolts and sealing kit, as applicable | 2 | sets |
| | l) | | Multi Disc assembly (for fluid coupling) | 2 | sets. of each type and rating |
| | m) | | Resilient Drive plate assy | 2 | sets. of each type and rating |

CLAUSE NO.

## MANDATORY SPARES

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| **J)** | | | **VIBRATING (GRIZZLY/SCREENING) FEEDER** | | |
| | i) | | Bearings | 2 | no. of each type & size |
| | ii) | | Seals | 2 | no. of each size |
| | iii) | | Liners | 1 | sets. |
| | iv) | | Screen plates | 10 | sets |
| | v) | | Complete vibrating assembly consisting of all rotating parts including drive & driven unbalanced shafts including bearings, casing, spring, vibrating blocks, main shaft, sheave & unbalanced weights as applicable. | 1 | set of each type and rating and direction |
| | vi) | | Hoses (if applicable) | 2 | set |
| | vii) | | Drive unit assembly (including electric motor, hydraulic pump, hydraulic motor, , flexible shaft, gear box, as applicable) | 1 | set |
| | viii) | | Base springs, rubber pads | 2 | sets. of each type & size |
| | ix) | | V belts | 4 | sets. of each type & size |
| **K)** | | | **ELECTRIC HOISTS** | | |
| | i) | | Brake linings | 2 | sets of each type |
| | ii) | | Rope guide & rope tightner | 1 | no. of each type |
| | iii) | | Limit switch | 2 | nos. of each type & size |
| | iv) | | Gear box/gear set | 2 | sets of each type |
| | v) | | Motor/geared motor | 1 | no of each type & rating |
| | vi) | | Drum bearing | 1 | set of each type & rating |
| **L)** | | | **FLAP GATES (INCLUDING THAT OF TRIPPERS)** | | |
| | i) | | Limit switch | 8 | nos. of each type & rating |

CLAUSE NO.

## MANDATORY SPARES

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | ii) | | Actuator (complete with motor, gear box,limit switches etc.) | 1 | nos. of each type & rating |
| | iii) | | Oil seals of Actuator | 2 | nos. of each type & rating |
| | iv) | | Flap gate shaft | 1 | nos. of each type & rating |
| | v) | | Pressure nut | 12 | nos. of each type & size |
| **M)** | | | **RACK & PINION GATE** | | |
| | i) | | Limit switch | 2 | no. of each type & size |
| | ii) | | Rollers with bearings | 2 | no. of each size |
| | iii) | | Motor gear box assembly | 1 | set of each type |
| | iv) | | Actuator (complete with motor, gear box, limit switches etc.) | 1 | nos of each type & rating |
| **N)** | | | **SUMP PUMP** | | |
| | i) | | Complete pump assembly with pump, motor, coupling base etc | 1 | set |
| | ii) | | Impeller with key & nut | 2 | set of each size & type |
| | iii) | | Oil seal | 2 | nos. of each size |
| | iv) | | Coupling bolt with bushes | 2 | set of each type |
| | v) | | Pump shaft | 2 | no. of each size |
| | vi) | | Shaft sleeve | 2 | sets of each size |
| | vii) | | Bearing bush | 2 | sets of each size |
| | viii) | | Set of bearings | 2 | sets |
| **O)** | | | **DUST SUPRESSION, SERVICE WATER, POTABLE WATER, COOLING WATER** | | |
| | a) | | Pump impeller with key & nut | 1 | set of each type & size |
| | b) | | Pump Shaft | 1 | no of each type & size |
| | c) | | Bearings | 1 | sets each type & size |

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | d) | | Wearing rings | 2 | sets of each type & size |
| | e) | | Shaft sleeve | 2 | sets of each type & size |
| | f) | | Bushings | 2 | sets of each type & size |
| | g) | | Coupling bolts & nuts (with bushes) 2 sets | 1 | sets each type & size |
| | h) | | Spray nozzles | 50 | nos.of each type & size |
| | i) | | Spray nozzles (for plain water dust suppression) | 25 | nos.of each type & size |
| | j) | | Solenoid valves | 5 | % of each type and size |
| | k) | | Globe valve / plug valves | 10 | % of each type and size |
| | l) | | Gate valve | 2 | nos. of each size |
| | m) | | Strainers | 1 | no. of each type |
| | n) | | Compressor | | |
| | (i) | | Air filter element | 8 | Nos. |
| | (ii) | | Oil filter | 6 | Nos. |
| | (iii) | | Discharge Check Valve | 3 | Nos. |
| | (iv) | | Oil Pump Parts (including distance ring, eccentric rings, Pump element, Pin, Key O, Ring) as applicable | 2 | Sets |
| | (v) | | Inlet Valve Assembly | 2 | Nos. |
| | (vi) | | Electronic regulator | 3 | Nos. |
| **P)** | | | **VENTILATION SYSTEM** | | |
| | i) | | V-Belt | 1 | set of each type |
| | ii) | | Pre-filter element of pressurizing fans | 2 | sets of each type |
| | iii) | | Foundation Rubber pads | 1 | sets of each type & size |
| | iv) | | Bearings | 1 | sets of each type & size |
| | v) | | Plummer Blocks | 1 | set of each type & size |

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| **Q)** | | | **TRAVELLING TRIPPER** | | |
| | I) | | Complete drive assembly including gear box, coupling, brake etc. | 1 | set |
| | ii) | | Complete internals of speed reducer (including input shaft, output shaft, gearset) | 1 | set of each size & type |
| | iii) | | Bearings for reducer | 2 | sets |
| | iv) | | Drive axle with wheels, plummer blocks, bearings etc. | 1 | set |
| | v) | | Oil seals | 2 | nos. of each size |
| | vi) | | Non-drive axle with wheels plummer blocks, bearings etc. | 1 | set of each type |
| | vii) | | Flap gate actuator with motor, gear box, position / thrust switches | 1 | set of each type |
| | viii) | | Chain assembly wiith sprockets | 1 | set of each type & size |
| | ix) | | Festoon Roller assembly for flexible cable | 4 | Nos |
| | x) | | Pulleys and plummer block bearings | 1 | no of each type |
| | xi) | | Plummer block with bearing for cable reel drums | 1 | set of each type |
| **R)** | | | **ELEVATOR** | | |
| | **a.** | | **Brake** | | |
| | | | 1. Tool to brake | 1 | No. |
| | | | 2. Fan | 1 | No. |
| | | | 3. Magnet coil with housing pads | 2 | Nos. |
| | | | 4. Brake pads | 6 | Nos. |
| | | | 5. Adjusting sleeve | 2 | Nos. |
| | | | 6. Fixed brake disc | 2 | Nos. |
| | **b.** | | **Worm Gear** | | |
| | | | 1. Worm gear | 1 | no. |
| | | | 2. 'O' ring | 2 | nos. of each |

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | | | | | type |
| | | | 3. Sealing ring | 2 | nos. of each type |
| | **c.** | | **Door Front** | | |
| | | | 1. Bearing | 2 | Nos. |
| | | | 2. Roller | 3 | Nos. |
| | | | 3. Bushing | 2 | Nos. |
| | **d.** | | **Limit Cams** | | |
| | | | 1. Sensor | 1 | No |
| | | | 2. Switch | 2 | Nos. |
| | | | 3. Switch arm | 2 | Nos. |
| | **e.** | | **CAD** | | |
| | | | 1. Guide roller | 50 | % of the total ones installed each type or minimum 1 no. whichever is higher |
| | | | 2. Switch | 1 | no. |
| | **f.** | | **Sliding Door** | | |
| | | | 1. Rollers | 4 | nos. of each type |
| | **g.** | | **Machinery** | | |
| | | | 1. Guide roller | 2 | nos. |
| | | | 2. Pinion | 1 | no. |
| | | | 3. Rubber inserts | 6 | nos. |
| | | | 4. Grove ring | 6 | nos. |
| | | | 5. Brake motor | 1 | no. |
| | **h.** | | **Cable trolley** | | |
| | | | 1. Ball bearing | 2 | nos. of each type |
| **S)** | | | **DUST EXTRACTION SYSTEM** | | |
| | 1 | | Fan Motor | 1 | nos. of each type & rating |
| | 2 | | Plummer Blocks | 2 | sets of each type |
| | 3 | | Bearing of fans & motor | 1 | set of each type |

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

| S.N. | | If Applicable (Y/N) | ITEM | QUANTITY | Unit |
|---|---|---|---|---|---|
| | 4 | | Pulley | 2 | nos of each type |
| | 5 | | Belts | 2 | sets of each size |
| | 6 | | Impeller and shaft of coal slury disposal pump | 1 | set of each type |
| | 7 | | Bearing of pumps | 1 | set of each type |
| | 8 | | Pump Motor | 1 | nos of each type |
| | 9 | | Motor terminal blocks with studs for all motors | 1 | set of each rating and type of motor |
| | 10 | | Spray nozzle | 10 | nos of each type |
| | 11 | | Solenoid valve with coil | 2 | nos of each type |
| **T)** | | | **BUCKET ELEVATOR** | | |
| | 1 | | Buckets | 10 | % of total population |
| | 2 | | Belt for bucket elevator | 10 | % of total population |
| | 3 | | Linkages | 20 | % of total population |

**Note** :

1. Unless stated otherwise a 'set' means items or sub-items required for each type/size range of the assembly/ sub-assembly, required for replacement in one main equipment. It is further intended that the assembly/ sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly/ sub-assembly, these shall be considered as different types of assembly/ sub-assembly.
2. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quality so calculated happens to be a fraction, the same shall be rounded off to next higher whole number.
3. Whenever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.
4. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.
5. Price of each and every item is to be given separately.

**1.25.00 CONTROL AND INSTRUMENTATION**

| | | |
|---|---|---|
| **1.00.00** | **CONTROL AND INSTRUMENTATION** | |
| 1.01.00 | **MEASURING INSTRUMENTS** | |
| 1.01.01 | 1.1 All type of Transmitters including sensors. | 10% or 1 no. of each type and model whichever is more. |
| 1.01.02 | 1. Temperature elements | |
| | 1.1 RTD's* of each type and length(with head assembly, terminal block & nipple) | 10% or 2 nos. of each type and length, whichever is more |
| | 1.2 Thermocouples of each type like K-type, R-type, metal etc. * (with head assembly, terminal block & nipple) | 10% or 2 nos. of each type and length which ever is more |
| | 1.3 Cold junction compensation boxes of each model (if applicable) | 10% or 2 nos. whichever is more |
| | 1.4 Thermostatic units for each model of CJC box (if applicable) | 10% or 2 nos. whichever is more |
| | 1.5 Temperature transmitters | 10% of each type and length |
| 1.01.03 | 1.1 Limit switches for isolation valves | 2 nos. of each type |
| | 1.2 Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges, flow meters etc., | 5% or 1 no. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make, model, type population) |
| | 1.3 Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices | 5% or 1 no. of each type and model whichever is more |

| | | |
|---|---|---|
| 1.01.04 | Any other instrument (Flow transmitter, Density meter) (as applicable) | 10 % or 1 no. of each type and model whichever is more |
| 1.02.00 | CEMS (SOx, NOx, CO, CO2, Mercury, Stack opacity, flue gas flow):- | |
| (a) | Analyzer for SOx, NOx, CO2, CO. | 1 no complete instrument of each type and model. |
| (b) | Flue gas flow measurement | 1 no. complete instrument along with sender/receiver unit |
| (c) | Stack Opacity measurement | 1 no. complete instrument along with sender/receiver unit |
| (d) | Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules | 10% of each type, model and rating |
| (e) | Set of gaskets/O-rings/ seals | 200% of each type, model, rating and size |
| (f) | Temp. Sensor | 20% of each type and model |
| (g) | Heater assembly, Cooler assembly | 20% of each type and model |
| (h) | Complete Probe with shield assembly (Not applicable for In situ- path) | 1 no. of each type and model |
| (i) | Solenoids | 2 nos. of each type, model and rating |
| (j) | Filters, light source, sensor, detector, etc. | 200% of each type, model and rating |
| (k) | Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges. | One year supply |
| (l) | Heavy duty blower assembly | 1 no. of each type, size and rating. |
| (m) | Rotameter/Air flow meter | 2 nos. of each type, model and rating |
| 1.03.00A | Analyzers (SO2, pH) for FGD system | 10% or 2 Nos of each type complete with accessories |

| CLAUSE NO. | MANDATORY SPARES | |
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| | | |
|---|---|---|
| 1.03.00B | Analyzers for ZLD system | |
| **i)** | PH Analyzer<br>(a) Flow Through type cell and Electrode<br>(b) Electronic Transmitter unity without sensor<br>(c) Pre-fabricated cable with connector | 1 no of each type<br>1 no of each type<br>1 set |
| **ii)** | Conductivity Analyzer<br>(a) Flow Through type cell and Electrode<br>(b) Electronic Transmitter unity without sensor<br>(c) Pre-fabricated cable with connector | 1 no of each type<br>1 no of each type<br>1 set |
| **iii)** | Turbidity Analyzer(if applicable)<br>(a) Flow Through type cell and Electrode<br>(b) Electronic Transmitter unity without sensor<br>(c) Pre-fabricated cable with connector | 1 no of each type<br>1 no of each type<br>1 set |
| **iv)** | Residual Chlorine Analyzer ( if applicable)<br>(a) Sensor<br>(b) Transmitter<br>(c) Pre-fabricated cable with connector<br>(d) All Chemical Reagents for 12 month operation (Supply to be staggered as per the shelf life) | 1 no of each type<br>1 no of each type<br>1 set<br>1 set |
| **v)** | Silica Analyzer ( if applicable)<br>(a) Main PCB assembly<br>(b) Power supply Cards(if applicable)<br>(c) Rubber Tubes & Capillary Tubes<br>(d) Pre-fabricated cable with connector<br>(e) Solenoid Valves<br>(f) All Chemical Reagents for 12 month operation(Supply to be staggered as per the shelf life) | 1 no of each type<br>1 no of each type<br>1 set<br>1 set<br>1 set |

| | | |
|---|---|---|
| **vi)** | Any other online analyser other than those covered above ( as applicable) | 1 set |
| 1.04.00 | PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable) | |
| | 1. Valves of all types and models | 10% or 1 no. of each type, class, size and model whichever is more. |
| | 2. 2 way, 3way, 5way valve manifolds | 10% or 1 no. of each type, class, size and model whichever is more. |
| | 3. Fittings | 10% or 1 packet of each type, class, size and model whichever is more. |
| | 4. Purge meters | 5% of each model or 1 no. whichever is more. |
| | 5. Filter regulators | 20% of each model or 2 nos. whichever is more. |
| 1.05.00 | CABLES | |
| | 1. Pre fabricated cable of each type. | 10% of installed quantity |
| | 2. Pre fabricated cable connector of each type | 10% or 1 no. of each type and model, whichever is more. |
| | 3. Other cables | 5% of each type, pair and size of actual installed quantity |
| 1.06.00 | 24V – DC POWER SUPPLY SYSTEM | |
| 1.06.01 | AC/DC isolators, contactors, timers, relays | 10% of each type and rating. |

| | | |
|---|---|---|
| 1.06.02 | Fuses of each type and rating | 200% |
| 1.06.03 | Fuse free Circuit breakers | 5% of each type and rating. |
| 1.06.04 | Electronic modules of all types | 10% of each type. |
| 1.06.05 | Cooling Fans | 2 nos. of each type |
| 1.06.06 | Relays of all types including overload relays | 10% of each type and rating |
| 1.07.00 | **PLC CONTROL SYSTEM** | |
| 1.07.01 | Power Supply Unit | 1 nos. of each type and model |
| 1.07.02 | Electronic modules(I/O modules, communication modules and any other module used in the system) | 10% or 1 no. of each type and model, whichever is more. |
| 1.07.03 | Central Processor Unit | 1 nos. of each type and model. |
| 1.07.04 | Interconnecting Cables | 10% of each type and size |
| 1.07.05 | Cooling Fan in PLC system / cabinet | 2 Nos. |
| 1.07.06 | Indication lamps of all types | 100% |
| | 1. Keyboards/mouse | |
| | 1.1 Keyboard | 2 nos. of each type. |
| | 1.2 Mouse | 2 nos. of each type. |
| | 2. Printers and their parts | |
| | 2.1 Color laser printer (A4) | 1 no |
| | 2.2 Long term storage unit | 1 no |
| | 2.3 Blank CDs | 10 boxes |
| | 3. HMIPIS Devices | |

| CLAUSE NO. | MANDATORY SPARES | |
|---|---|---|

| | | |
|---|---|---|
| | 3.1 OWS with licensed software loaded along with monitor | 2 nos. of each type and model. |
| | 3.2 Server for unit LAN or Information Work Stations (As applicable) | 1 nos. |
| | 3.3 Net work components like Switch /repeaters/hubs etc. (as applicable) | 2 nos. of each type and model. |
| | 3.4 Control units for LVS | 1 no. |
| | 4. Cables and Connectors. | |
| | 4.1 Prefab interconnecting cables with connectors | 2 nos. of each type and length. |
| | 4.2 System bus cable with connectors | -do- |
| | 4.3 I/O bus cable with connectors for remote I/O units | -do- |
| | 4.4 Power Supply Modules & Power Packs for control system | 10% of each type model and rating, whichever is more |
| | 5. Electronic modules of each type and model for control system (This shall include all type of cards like I/O cards, controller cards, CPU module or Card, logic cards etc.) | 10% or 2 nos. of each type and model whichever is more |
| | 6. Bus coupler/Interface hardware and other communication devices. | 10% of each type and model |
| | 7. Relays | 10% of each type and rating |
| | 8. Batteries used for battery backup of RAMs. | 10% of each type and model |
| | 9. Fuses | 200 % |

| | | |
|---|---|---|
| 1.08.00 | **OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS / EQUIPMENTS** | |
| | 1. Lime Feeders | |
| | 1.1 Motion monitor | 10% or 2 nos. whichever is more. |
| | 1.2 Speed pick-up | 10% or 2 nos. whichever is more. |
| | 1.3 Torque switch (if applicable) | 10% or 2 nos. whichever is more. |
| | 1.4 Load Cell | 10% or 2 nos. whichever is more. |
| | 1.5 Electronic cards & Power Supply cards | 10% or 2 nos. whichever is more. |
| | 1.6 Clutch (if applicable) | 10% or 2 nos. whichever is more. |
| | 1.7 Local indication lamps | 200 % |
| | 1.8 Panel meters | 10% or 2 nos. whichever is more. |
| | 1.9 Limit switch assembly for lime-on-belt, no lime flow, shear pin failure, etc. | 10% or 2 nos., whichever is more. |
| 1.09.00 | **CONTROL VALVES, ACTUATORS & ACCESSORIES (Following items shall be provided under this clause for all modulating control valves being supplied under this package)** | |
| | 1. Pneumatic and electro-hydraulic actuator assembly | 10% or 1 no. of each type, model and rating, whichever is more. |
| | 2. Valve trim (including cage, plug, stem, seat rings, guide bushings etc.) | 1 set for each type of control valve. |

| | | |
|---|---|---|
| | 3. Diaphragms, O' rings, seals etc. of all types make etc. | 100% |
| | 4. Pressure Gauges of all types, make, rating etc. | 10% or 2 nos. of each type whichever is more |
| | 5. Solenoid valves (if applicable) | 10% or 2 nos. of each type whichever is more |
| | 6. Positioner units (complete unit)& accessories (link assembly) | 10% or 1 no. of each type whichever is more |
| | 7. Pneumatic air-filter/Regulator of each type, make rating etc. | 10% or 2 Nos., whichever is more |
| | 8. Air lock relays | 10% or 2 nos. of each type whichever is more |
| 1.10.00 | **PNEUMATICS ISOLATION / BLOCK VALVES, ACTUATORS & ACCESSORIES (For all ON/OFF valves supplied under this package)** | |
| | 1. Pneumatic actuator assembly | 10% or 1 no. of each type, model and rating, whichever is more. |
| | 2. Diaphragms, O' rings, seals etc. of all types make etc. | 100% |
| | 3. Limit switches (complete unit)& accessories (link assembly) | 10% or 2 Nos., whichever is more |
| | 4. Pneumatic air-filter/Regulator of each type, make rating etc. | 10% or 2 Nos., whichever is more |

**1.26.00 ELECTRICAL**

**1.01.00 LT Switchgear:**

**Part A:**

| S.No. | Item Description | Quantity |
|---|---|---|
| 1 | Complete breaker | 10% of each type & rating(min 1 No) |
| 2 | Ammeter | 2 Nos of each type, size & range |
| 3 | Voltmeter | 2 Nos of each type, size & range |
| 4 | Relays | 10 % of each type (min 2 Nos) |
| 5 | Bus bar support insulators ~~(Porcelain)~~ | 10 Nos. |

**Part B:**

| | | |
|---|---|---|
| 1 | Spring charging motors | 3 Nos of each type & rating |
| 2 | Aux. Contact set | 6 sets of each type & rating |
| 3 | Limit switches | 10 Nos of each type. |
| 4 | Arc chutes | 10% of each type & rating |
| 5 | Fixed contact set | 3 Nos sets of each type & rating |
| 6 | Moving contact set | 3 Nos sets of each type & rating |
| 7 | Arcing contact | 3 Nos sets of each type |
| 8 | Charging spring | 2 Nos of each type & rating |
| 9 | Current transformer | 3 Nos of each type & |

| | | |
|---|---|---|
| | | ratio |
| 10 | Closing coil | 6 Nos of each type & rating |
| 11 | Trip coil | 6 Nos of each type & rating |
| 12 | CT for Bimetal O/L relays | 3 Nos of each type & rating |
| 13 | Voltage transformer | 3 Nos of each type & ratio |
| 14 | Control supply transformer | 3 Nos of each type and rating |
| 15 | (a) Power contactor | 2 Nos of each type & rating |
| 16 | (b) Coil of above contactor | 2 Nos of each type & rating |
| 17 | Air break switches/ MCCBs | 3 Nos of each type & rating |
| 18 | DP air break switches(DC) | 3 Nos of each type & rating |
| 19 | Control & selector switches | 3 Nos of each type & rating |
| 20 | Control fuses & neutral links | Total 50 Nos (Fuses) & ~~5%~~ 10 Nos (Neutral links), to cover all the ratings. |
| 21 | Indicating lamps | Total 30 Nos to cover all the types & ratings |
| 22 | Vertical bus bar dropper support insulators | 25 Nos. |
| 23 | Bus duct flexible connectors (both transformer and switchgear end) | 1 set for thee phases of each type & size |
| 24 | (a) Primary disconnect in MCC (Bus bar end)(Male/female contact) | Total 15 Nos. proportionately divide for all ratings |

| | | |
|---|---|---|
| 25 | (b) Secondary disconnect in MCC (Cable end) | Total 15 Nos. proportionately divide for all ratings |
| 26 | Push buttons | 10 Nos of each type |
| 27 | Power fuses | Total 20% proportionately divide for all ratings (min 3 Nos) |
| 28 | Thermal Bimetal relays | Total 5%. proportionately divide for all ratings (min 1 No) |
| 29 | Current transducers | 2 Nos of each type & rating |
| 30 | Voltage transducers | 2 Nos of each type & rating |
| 31 | Busbar aluminium flat pieces | 12 meters of each type & rating |
| 32 | Busbar angles/formed pieces for breaker | 2 Nos. of each type |
| 33 | Terminal blocks | 12 Nos of each type & rating |
| **1.02.00 ELECTRICAL ACTUATORS** | | |
| 1 | Actuators | 1 no of each type and rating |
| **1.03.00 LIGHTING** | | |
| 1. | LED Fixture | 5 nos of each type and rating |

| 1.04.00 MV SWITCHGEARS | | |
|---|---|---|
| 1 | Breaker of each rating | 10% of each type & rating (Min 1 No.) |
| 2 | Numerical relays | 10% of each type (Min 2 Nos) |
| 3 | Aux. Relays/ Lock out relays/ Timers(if applicable) | 10% of each type (Min 2 Nos) |
| 4 | Bus bar support insulators | 12 Nos. |
| 5 | Energy meter of each type & range | 1 Nos. of each type |
| 6 | Spring charging motor complete | 2 Nos. of each type. |
| 7 | Current transformer of each type & ratio | 3 Nos. of each type |
| 8 | Potential transformer of each type & ratio | 3 Nos. of each type |
| 9 | Shunt trip coil | 5 Nos. of each type & rating |
| 10 | Closing coils | 5 Nos. of each type & rating |
| 11 | Moving contact assembly of each rating (One set means complete replacement for one breaker) | 2 sets |
| 12 | Stationary (fixed) contact of each rating (One set means complete replacement for one breaker) | 2 sets |
| 13 | Bus seal off bushings | 3 nos. of each type & size |
| 14 | Limit switches | 10 Nos. of each type |
| 15 | Control switches | 2 Nos. of each type |
| 16 | Selector switches | 2 Nos. of each type |
| 17 | Isolation switch for the control supply | 2 Nos. |

| | | |
|---|---|---|
| 18 | Circuit breaker auxiliary contact assembly | 6 Nos. of each type & rating |
| 19 | Indicating lamps with holders | 20 set |
| 20 | (a) Fuse base and holder | 12 Nos. |
| | (b) Fuse link | 12 Nos. |
| 21 | Isolating contact ( fixed & moving)( one set means male & female contacts of one complete breaker) | 4 sets of each rating |
| 22 | Terminal blocks | 6 Nos. |
| 23 | Multiple pin plug contact assy. with cables (male & female) | 6 Nos. |
| 24 | Inter-phase barrier | 2 Nos. of each type |
| 25 | Vacuum Contactors with HRC fuses (if applicable) | 2 Sets (One set = Three fuses) |
| 26 | Surge arresters | 3 Nos. of each rating |

**1.05.00 MV Busduct**

| | | |
|---|---|---|
| a | Support insulators of each type | 10 Nos. |
| b | Three phase set of flexible terminal connectors for switchgear end of each type & rating | 1 set |
| c | Three phase set of flexible terminal connector for transformer end of each type & rating | 1 set |
| d | Seal off bushings of each type & rating | 3 nos. |

NOTE: ONE SET MEANS COMPLETE REQUIREMENT OF ONE PHASE, WHEREVER NOT SPECIFIED

## 1.06.00 TRANSFORMER

| Sr. No. | ITEMS DESCRIPTION | Transformer (For each type/rating) |
|---|---|---|
| 1. | HV Bushing with metal parts and gaskets | 2 Nos. |
| 2. | LV bushing with metal parts and gaskets | 2 Nos. |
| 3. | LV Neutral bushing with metal parts and gaskets | 2 Nos. |
| 4. | WTI with contacts | 1 No. |
| 5. | OTI with contacts | 1 No. |
| 6. | Pressure relief device | 1 No. |
| 7. | MOG | 1 No. |
| 8. | Buchholz relay complete | 1 No. |
| 9. | Set of gaskets (See Note 1) | 1 Set |
| 10. | Set of valves | 2 Nos. of each type/size |
| 11. | Air cell for conservator | 1 No. |
| 12. | Neutral Grounding Resistor w/o supporting structure | 1 No. |

**Note 1:** 1 set consists of gaskets required for 1 No. transformer for the following

(a) Protection and monitoring devices

(b) Cooler circuit

(c) Largest inspection cover, if applicable

(d) HV/LV turret, if applicable

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

NOTE:

**1.** Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.

**2.** Any fraction of a item shall mean the next higher integer.

**3.** Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case, the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.

**4.** Wherever the quantities have been indicated for each type, size, thickness, material, radius, range, etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.

**5.** In case, spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.

| CLAUSE NO. | MANDATORY SPARES | |
|---|---|---|
| **1.27.00** | **MANDATORY SPARES FOR CHIMNEY ELEVATOR (Qty. indicated are for one (1) No. Chimney Elevator)** | |
| A. | BRAKE | ASSEMBLY Qty. |
| | 1. Brake Assembly complete | 1 No. |
| B. | GEAR ASSEMBLY | |
| | 2. Gear Assembly complete | 1 No. |
| C. | DOOR FRONT | |
| | 3. Bearing | 3 Nos. |
| | 4. Roller | 3 Nos. |
| | 5. Bushing (if applicable) | 2 Nos. |
| D. | LIMIT CAMS | |
| | 6. Sensor | 3 Nos. |
| | 7. Switch arm | 3 Nos. |
| E. | CAB | |
| | 8. Guide roller | 100% of the total ones installed each type or min. 1 no. whichever is higher |
| | 9. Switch | 3 Nos. |
| F. | SLIDING DOOR | |
| | 10. Rollers (if applicable) | 4 Nos. each type |
| G. | MACHINERY | |
| | 11. Guide roller | 2 Nos. |
| | 12. Pinion | 2 Nos. |

| CLAUSE NO. | MANDATORY SPARES | |
|---|---|---|
| | 13. Rubber inserts (if applicable) | 12 Nos. |
| | 14. Groove ring (if applicable) | 6 Nos. |
| | 15. Brake motor | 1 No. |
| H. | CABLE TROLLEY BEARING (if applicable) | |
| | 16. Bearing | 3 Nos. of each type |
| I. | ELECTRICAL EQUIPMENTS | |
| | 17. Contactors | 1 No. of each type |
| | 18. Auxiliary transformer | 1 No. |
| | 19. Relays | 1 No. of each type & rating |
| | 20. Switch | 2 Nos. each type |
| | 21. Rectifier | 3 Nos. |
| | 22. Limit switch | 3 Nos. each type |
| | 23. Transmitter (if applicable) | 1 No. if applicable |
| | 24. Receiver (if applicable) | 1 No. if applicable |
| | 25. Battery charger | 1 No. |
| | 26. Push Buttons | 3 Nos. of each type |
| | 27. Timers | 2 Nos. of each type & rating |
| | 28. Main drive motor with control system | 1 Set |

# NTPC Limited

(A Government of India Enterprise)

# LOT 1A PROJECTS

# PART – B
# (DETAILED TECHNICAL SPECIFICATION)

## SUB-SECTION-IV-D
## (CIVIL WORKS)

## SECTON – VI

## TECHNICAL SPECIFICATION

## FOR

## FLUE GAS DESULPHURISATION (FGD)

## SYSTEM PACKAGE

**BIDDING DOCUMENT NO. : CS-0011-109(1A)-2**

# PART – B (DETAILED TECHNICAL SPECIFICATION)

# SUB-SECTION-IV-D (CIVIL WORKS)

# SUB-SECTION-IV-D

# CIVIL WORKS

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **1.00.00** | **GENERAL** |
| **1.01.00** | This section of the bidding document deals mainly with the technical specification for the design and preparation of detailed drawings, getting the design and drawings approved by the Employer, fabrication, erection and construction of the necessary civil, structural and architectural works associated with the FGD package for **Lot-1A**. The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, silos, sumps, Limestone storage hopper & shed, Crusher House, Transfer points, Conveyor Galleries, Tunnels, Gypsum storage shed, Chimney, Gypsum dewatering building, Ball Mill building, FGD control room building, Tank Foundations, absorber tower foundation, transformer foundation, MCC Building, finishes, complete architectural aspects, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD package. |
| **1.02.00** | The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. In absence of the above, the work shall be executed according to the best prevailing local Public Works Department practices or to the recommendations of relevant American and British Standards or to the instructions of the Engineer. Some of the relevent I. S. Codes to be followed is mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document. |
| **1.03.00** | Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for power plant structures or steel plant or Industrial structures like Petro/ Chemical/ Refinery/ Cement/FGD Plant/Coal Handling Plant/Ash Handling Plant etc.<br><br>The designer responsible for preparation of scope drawings shall review and approve the fabrication drawings prepared by the detailer before releasing them for fabrication. |
| **2.00.00** | **Sub QR for Civil Works:** |
| 2.01.00 | Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels. |
| 2.02.00 | Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 2.01.00. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 2.03.00 | For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height. |
| 2.04.00 | In case Bidder or its agency do not meet the requirements at 2.01.00 and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, earthwork in filling involving mechanical compaction and cutting in hard rock, RCC in underground storage hopper and underground tunnels ) for which it is being engaged.<br><br>Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them. |
| | **Design agency for Civil & Steel Structural Works:** |
| 2.05.00 | Bidder or its agency (ies) should have carried out the design and detailed engineering of following works:<br>(i) Civil & Structural works associated with at least one bulk material handling plant for 500 MW or higher capacity coal based/Lignite based power plant.<br>(ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height.<br>(iii) Machine foundations such as Mill foundations/ Block foundations. |
| 2.06.00 | Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 2.05.00.<br><br>The design agency (ies) proposed by the Bidder shall be subject to Employer's approval. |
| **3.00.00** | **Work Description** |
| **3.01.00** | **Truck Hopper, Limestone Storage hopper and Underground Tunnel**<br><br>Truck Hopper shall consist of underground portion, which shall be of R. C. C. with structural steel shed covered with permanently Colour coated profiled steel sheets.<br><br>Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets.<br><br>The structural arrangement to be adopted for the design and construction of Limestone Storage hopper shall essentially consist of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. Minimum thickness of R. C. C. raft at bottom shall be 600 |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top.<br><br>The vertical and inclined portion of hopper shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification.<br><br>Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material.<br><br>Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover.<br><br>Water proofing / Damp proofing of under ground Truck hopper, Limestone Storage hopper, tunnels and underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments:<br><br>Chemical injection grouting for inner faces (details as specified elsewhere).<br><br>Polymer modified cementitious coating on earth side face as per the following :<br><br>(1) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface.<br><br>(2) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers ( slurry mix application ) as per manufacturer's specification. 50 mm thick P. C. C. ( 1 : 2 : 4 ) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft.<br><br>Truck hopper and its gratings shall be designed for movement of front end loader/ bulldozer over them. Bull dozer weight shall be considered as about 35T. The gratings shall be built of min. 200x28mm thick flats in main direction and min.100mm x 20mm thick in secondary direction. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication.<br><br>Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches.<br><br>Earth pressure to be considered for design shall be due to earth pressure at rest (Ko) condition only. Earth pressure due to surcharge intensity of Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. shall be considered in the design.<br><br>A minimum safety factor of 1.2 against uplift due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | 0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees.<br><br>Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case.<br><br>Wherever, slope of tunnel exceeds $10^o$, R. C. C. steps shall be provided for the entire width of each walkway. |
| **3.02.00** | **Overhead / Ground Conveyor Galleries and Trestles**<br><br>Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Contractor can also use tubular steel sections for roof truss only of conveyor galleries. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS 1161 and rectangular/square steel sections shall conform to IS 4923. The steel structures using tubular sections shall be designed and fabricated as per IS 806 – "Code of Practice for use of steel tubes in general building construction." and EN 1993-1-8:2005. The maximum span of overhead gallery shall be limited to 25 meters unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made.<br><br>Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor.<br><br>The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors.<br><br>For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than $10^o$, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification.

Cross - over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 100 M intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location.

For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.0m above the road crest / rail top shall be provided.

For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc.

Thus material load per unit length of each moving conveyor shall be

$$1.6 \times \frac{\text{Rated capacity of conveyor system}}{\text{Conveyor Belt Speed}} \times F$$

Where, F = 1700/1400 for lime & 1250/900 for gypsum

It should be noted that for structural design, unit weight of lime shall be assumed as 1700 Kgs. / Cu. M. instead of 1400 Kgs. / Cu. M., unit weight of gypsum shall be assumed as 1250 Kgs. / Cu. M. instead of 900 Kgs. / Cu. M. considered for system sizing purpose. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously.

Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways.

a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.<br><br>End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa.<br><br>For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level. |
| **3.03.00** | **Transfer Houses**<br><br>The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and R. C. C. floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Contractor shall have option to use tubular steel sections for roof truss only. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.<br><br>Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting.<br><br>The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **3.04.00** | **Crusher House**<br><br>The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building cubicles are to be provided for resting room of operators and these shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Contractor shall have option to use tubular steel sections for roof truss only . Vertical bracings shall be provided only on four sides along the periphery.<br><br>The roof of Crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.<br><br>Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification |
| **3.05.00** | **Control building, M. C. C. Buildings**<br><br>These shall be steel or RCC framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only ) over structural beams. Cladding shall be of brickwork/concrete blockwork with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations.<br><br>All air - conditioned areas, shall be provided with the suspended permanently colour coated aluminium false ceiling system (details specified elsewhere) with under deck insulation.<br><br>Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing. |
| **3.06.00** | **Pent House**<br><br>These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation. |
| **3.07.00** | **Gypsum Storage Shed**<br><br>The Gypsum storage shed shall be RCC framed structure with structural steel work shed with permanently colour coated profiled steel sheet roof and side cladding, grade slab and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet with adequate slope for quick drainage of rain water. |
| **3.08.00** | **Toilets**<br><br>Toilet with potable water line facilities shall be provided in each of the following locations:<br><br>(a.) In all M. C. C. Rooms<br><br>(b.) Control Building |
| **3.09.00** | **Staircases, Gratings, Handrails**<br><br>All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. All staircases of Transfer points and crusher house shall be of steel. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses, single storey mcc rooms & mumty. All Stairs shall be minimum 1200 mm wide, maximum rise should not be more than 180 mm and minimum tread with 250 mm. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. For steel staircases , Stringers shall be of rolled steel channel ( minimum ISMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's<br><br>All gratings shall be electro forged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. However, at entry or road crossing point's minimum thickness of grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is more than the specified load, then actual load is to be considered. All gratings shall be hot dip galvanized at the rate of 610 g. per sq.m. after surface preparation by means of blast cleaning/ acid pickling.<br><br>Minimum 1000 mm high hand railing shall be provided around all openings, projections / balconies, walkways, platforms, Stairs, etc. All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class) as per IS:1161. Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100 |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | mm high and 6 mm thick). All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736. |
| **3.10.00** | **Trenches** |
| | All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L and sand filling shall be overlaid with 50 thk. PCC.<br><br>Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover |
| **3.11.00** | **Cable gallery/trestles** |
| | Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and **EN 1993-1-8:2005**. |
| **3.12.00** | **Transformer Foundation** |
| **3.12.01** | Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Block foundations shall be provided for the main transformer block.<br><br>The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between gravel filling. However, in case a separate oil collection tank is provided for the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit.<br><br>Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/ reactor foundations. |

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| | RCC Firewall shall also be provided between the transformers wherever required.<br><br>300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of gravel filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement. |
| **3.12.02** | **Fencing**<br><br>Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.<br><br>Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing |
| **3.13.00** | **Booster Fan Foundation**<br><br>Booster Fan foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round. |
| **3.14.00** | **CHIMNEY** |
| **3.14.01** | **Salient Features**<br><br>Single-flue or multi-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level.<br><br>The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel |

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| | bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing.<br><br>The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be bottom supported and shall be profiled into a circular shape to connect to the flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic fluroelastomeric fabric expansion joint.<br><br>The expansion joint in the flue liner shall comprise of non-metallic fluoroelastomeric material suitable to withstand a temperature of 300 Deg C, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable to withstand a temperature of 300 Deg C and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh.<br><br>Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be provided for full height of the chimney and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch.<br><br>The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, mild steel wind strakes (if required), all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects.<br><br>Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance.<br><br>The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments. |

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| **3.14.02** | **Design Concept**<br><br>Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards.<br><br>In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail.<br><br>Imposed loading for design of all chimney components shall not be less than 5 kN/ Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load.<br><br>The min. thickness of web for plate girders shall be kept as 12 mm.<br><br>Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document.<br><br>Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document.<br><br>The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. Design of all chimney components shall be based on working stress method. |
| **3.14.03** | **Wind Shield**<br><br>The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998 (Part 1) : 1992. The wind shield shall be analysed for cases with and without flue liner loads.<br><br>Forces/stresses in the wind shield due to eccentricity effects of local (e.g. corbel) loadings, insolations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered.<br><br>Seismic response of the chimney shall be computed by the response spectrum method. At least, the first five modes of vibrations shall be used for this analysis.<br><br>The cross wind analysis of the chimney shall be carried out irrespective of the value of the Scruton Number for the chimney and other empirical considerations which suggest structural immunity to cross wind oscillations.<br><br>The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm.<br><br>The stresses for the shell design shall not exceed the limits given in Cl. 7.0 of IS:4998 (PART-I) 1975 for various combinations of loads, excepting the stress in concrete for the case of dead load + wind load which shall not exceed 0.30fck where fck is the characteristic compressive strength of concrete.<br><br>The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield |

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| | shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm.<br>There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings.<br>There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a sudden change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.<br>The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height upto the top level of flue duct opening.<br>Shell thickness between any two 10m reference levels shall not vary more than 150mm.<br>The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm.<br>Grade of concrete for chimney shell, and other super structure shall be minimum M 30. Only OPC cement shall be used for Chimney shell and other super structure.<br>The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located in the area or in the future expansion stage of the project shall be determined along with the other topographical features of the local area through model test. |
| **3.14.04** | **Flue Liners**<br>The flue gas parameters & various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification.<br>For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild steel base metal shall, however, not be less than that specified elsewhere in the specification.<br>Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels.<br>The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.<br>Clean-out door shall be provided below the flue for the removal of ash. |
| **3.14.05** | **Internal Platforms**<br>The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly for impact effects. These platforms shall also be designed suitably for |

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| | the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000. |
| **3.14.06** | **Internal Staircase**<br><br>The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm. |
| **3.14.07** | **Foundation**<br><br>The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation for any loading condition. Since chimney is a wind sensitive structure no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. No allowance shall be made in the stresses for design of foundation for wind loading. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 25. |
| **3.14.08** | **Thermal insulation**<br><br>The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/oC at a mean temperature of 100oC.<br><br>The insulation thickness shall be determined based on the maximum/minimum ambient temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 55 degree Celsius. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness.<br><br>The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanised wire mesh using MS galvanised pins and speed washer. |

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| **3.14.09** | **Chimney Painting**<br>(i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) except surfaces of steel wind strakes shall be painted as specified in corrosion protection clause of this specification.<br>(ii) All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT.<br>a) All steel surfaces shall be provided with two component epoxy primer coat (having solid by volume minimum 51% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique.<br>b) Primer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.<br>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 $\Delta$E) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.<br>(iii) All steel parts embedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.<br>(iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.<br>a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free.<br>b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.<br>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours |

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| | exposure, Gloss loss less than 30 and colour change less than 2.0 $\Delta E$) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.<br>d) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours. |
| **3.14.10** | **Electrical System**<br><br>415V, normal and emergency AC power supply for chimney shall be derived from main plant power supply system. Emergency supply shall feed 20% of platform lighting, 50% of staircase lighting, aviation obstruction lighting and elevator load. All other loads shall be connected on normal power supply.<br><br>Ambient temperature for design of all equipment shall be considered as 55 deg. C which is likely to be encountered inside the chimney. The equipment shall be suitable for installation and render trouble free operation at higher ambient temperature and rigorous weather conditions prevailing at chimney.<br><br>All equipment supplied shall comply with relevant IS Standards.<br><br>The distribution boards of chimney shall comprise switch fuse units of appropriate ratings. Emergency board shall have two incomers, one from emergency supply and other from normal AC distribution board itself. Auto changeover scheme shall be provided in emergency board to enable changeover to healthy source on failure of any source.<br><br>Dry type isolating transformer of Dyn connection shall be provided in emergency board to obtain neutral lead, in case 3 phase 3 wire emergency supply is derived from main plant.<br><br>Various platforms shall be illuminated by dust tight HPSV well glass lighting fixtures. Average illuminations level of 150 lux shall be maintained on equipment and 70 lux on platforms & 100 lux on staircases (minimum 1 lighting fixture at each landing).Any additional fixture to take care of dark patches/shadows shall also be provided. Lighting system shall be controlled through MCB provided in lighting panel.<br><br>A lighting and power panel each shall be located at grade level and at other in between levels as required. All distribution boards, aviation lighting controls, etc. shall be located at grade level only. At each platform, 1 No. 63A, 415V welding receptacle and 1 No. 20A, 240V receptacle shall be provided and shall be fed from power panel. Wiring installation for lighting fixture shall be of PVC insulated copper/aluminium wires through galvanised steel conduits.<br><br>Aviation obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organization (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA). The type of aviation obstruction lighting system shall be of medium intensity aviation obstruction lights having an effective intensity of 2000 to 20,000 cd depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 20000 cd. The intensity of lights shall be 20000 cd ± 25% at twilight and shall reduce automatically to a night time intensity of 2000 cd ± 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction |

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| | lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc..<br><br>A temporary aviation obstruction lighting system shall be provided during construction of the chimney.<br><br>Cables from distribution board to lighting panels/power panels/receptacles shall be 1100V grade, multicore FRLS HR-PVC insulated, PVC inner sheathed, armoured, PVC outer sheathed stranded copper/ Aluminuim laid on galvanised sheet steel cable trays. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs. Minimum size of the power cable shall not be less than 2.5 sq.mm copper or 4 sq.mm Aluminuim. Minimum size of control cable shall not be less than 1.5 sq.mm.<br><br>Lightning protection system shall comprise minimum 3 vertical air terminations for each flue liner, horizontal air terminations and minimum 4 Nos. of down conductors spaced 90 degrees apart routed all along chimney height on external surface and connected to the earthing system. Down conductors shall be of minimum 50x6 mm galvanized steel strip. Each down conductor shall be provided with a test link at 1 metre above ground level. Each test link shall be enclosed in a galvanised sheet steel enclosure. Above ground level earthing and lightning protection system shall comprise galvanised steel strips. These materials provided at top 12 meters shall have additional coating of 2 mm thick seamless lead cover and the accessories like nuts, bolts, washers etc. shall be of stainless steel to take care of corrosion. Chimney earthing system shall be interconnected to main plant earthing system.<br><br>A temporary lightning protection & earthing system shall be provided during construction of the chimney till a permanent lightning protection & earthing system is installed. In no case reinforcement bars of Shell should be used as earthing Down Conductors<br><br>Communication system comprising of telephone socket at every internal platform level and at grade level, necessary wiring installation, a telephone hand set, junction boxes etc. shall also be provided. Telephone cables shall be of minimum 0.6 mm diameter annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, rip corded, PVC sheathed, conforming to relevant ITD (Indian Telephones Department) specifications.<br><br>All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all type tests as listed below:<br><br>(A) Distribution boards/panels-Degree of protection tests<br><br>(B) Aviation lights:<br><br>(1) Intensity Test<br><br>(2) Degree of protection test<br><br>For various equipment, the technical requirements and practices shall conform to the relevant clauses of the main plant electrical specification. |
| **3.14.11** | **Rack and Pinion Elevator**<br><br>A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed |

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| | of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual |
| **4.00.00** | **Drainage & Water Supply Works** |
| 4.01.00 | Drainage System:<br><br>The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the facility buildings etc. with water periodically.<br><br>Minimum 4 nos. down comers shall be provided in each building at corners.<br><br>For Conveyors, each down comer shall lead the water / slurry to pit (of 2 Cu.M capacity) to allow settling of lime/gypsum. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.<br><br>For Ball Mill building, Gypsum dewatering building, FGD control room building, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling. The water from the pit shall overflow into contractor's R.C.C drain, and finally into owner's drain routed alongside the nearby road.<br><br>In case of Control rooms and M. C. C. buildings Pump houses, etc, water / slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / slurry into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.<br><br>Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities. |
| **4.02.00** | **Internal and external water supply, drainage etc.**<br><br>The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in the specifications. |

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| | The scope for service water supply and dust control water supply shall be as described elsewhere in the specifications.<br><br>For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used.<br><br>All facility buildings shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around facility building shall be of R. C. C. construction. Drains shall have removable steel grating cover and shall be provided with edge protection angles.<br><br>The scope for foul water from toilets shall include layout and laying of sewers up to the Employer's main sewer line for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers within the building and from the building to the Employer's sewer line.<br><br>For rain water down comer and those to be used for conveying water / slurry generated from cleaning of buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, penthouse, control rooms, ball mill building, gypsum dewatering building, storage sheds.<br><br>Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629.<br><br>All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti corrosive painting over a coat or primer.<br><br>For design of building drainage system IS: 1742 shall be followed.<br><br>For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints.<br><br>For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided.<br><br>For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch. |
| **5.00.00** | **COLOUR COATED AND OTHER SHEETING WORK** |
| **5.01.00** | **Material**<br><br>**a) Wall Cladding & Roofing Material**<br><br>Troughed permanently colour coated sheet of approved shade and colour shall be |

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| | **i)** either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150<br>**ii)** or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150<br>**iii)** or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150<br><br>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.<br><br>**b) Metal Deck Roof Material**<br><br>Troughed permanently colour coated metal decking sheets shall be<br><br>**i)** either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275<br>**ii)** or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275<br>**iii)** or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275.<br><br>Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking.<br><br>Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided. |
| **5.02.00** | **Colour Coating**<br><br>Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728. |
| **5.03.00** | **Design Criteria**<br><br>For wall cladding insulated / uninsulated sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm. |

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| | For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements.<br><br>For metal deck sheets used for roofing ( with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition. |
| **5.04.00** | **Fasteners**<br><br>Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.<br><br>Shear anchor studs shall also be provided through troughed permanently colour coated metal decking sheets metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams.<br><br>The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.<br><br>The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.<br><br>Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location. |
| **5.05.00** | **Miscellaneous Details**<br><br>To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing. |

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| | Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners.<br><br>Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277<br><br>Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets<br><br>. Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer.<br><br>All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer. |
| **5.06.00** | **Pre-Fabricated Insulated Metal Sandwich Panels**<br><br>For structures where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be<br><br>**i)** either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150<br>**ii)** or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150<br>**iii)** or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150.<br><br>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.<br><br>Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade. |

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| | Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below.<br><br>The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site. |
| **5.07.00** | **Polycarbonate Sheets**<br><br>The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details |
| **6.00.00** | **Roof Details** |
| **6.01.00** | Roof slab shall be minimum 150 mm thick(**above the top surface (crest) of the metal deck sheet**) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. |
| **6.02.00** | 900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings. |
| **6.03.00** | Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet. |
| **6.04.00** | Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster. |
| **6.05.00** | Roofs of all control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows:<br><br>1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat.<br>2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898).<br>3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping.<br>4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C. |
| **6.06.00** | For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by |

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| | screed concrete M-15 (using 12.5 mm coarse aggregate) and/ or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface. |
| **6.07.00** | Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work, to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3. |
| **6.08.00** | Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings all shall be through cage ladder as per requirement. |
| **6.09.00** | Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster. |
| **6.10.00** | The rainwater down comers shall be provided with suitable C.I. grating at inlet point. |
| **7.00.00** | **RCC Floors, Paving & Grade Slab details**<br><br>The floor slabs shall be minimum 150 mm thick(above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.<br><br>In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification.<br><br>Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base.<br><br>Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided.<br><br>R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery.<br><br>RCC paving of minimum 150 mm thick with M25 grade concrete, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving and 400mm |

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| | compacted thick for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm dia bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm dia bars @ 200 mm c / c in both directions at the centre of the slab.<br><br>Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification.<br><br>Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area with 50 mm thick metallic hardener topping.<br><br>Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving.<br><br>All facility buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand<br><br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings.<br><br>Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level.<br><br>Suitable open RCC drains shall be provided to dispose off storm water drain. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.<br><br>Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD block to sewage pump house.<br><br>**GRADE SLAB OF BUILDINGS AT GROUND FLOOR**<br><br>In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, stone soiling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided.<br><br>Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping. |

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| **8.00.00** | **Brickwork and allied masonry works**<br><br>All brick walls shall be non - load bearing in-filled panel walls.<br><br>All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar. Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.<br><br>Bricks to be used in brickwork shall be of minimum Class designation 50.<br><br>Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness.<br><br>Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar.<br><br>50 mm thick Damp proof course shall be provided at plinth level for all brick wall.<br><br>All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster. |
| **9.00.00** | **Earthing Mat**<br><br>40 mm Dia MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per the approved drawings. Risers of 40 mm Dia MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Risers shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on outside of the buildings, and minimum 2 (Two) numbers for structures and outdoor equipment. The contractor also supply and lay necessary number of 3.0 M deep vertical 40 mm Dia MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40 mm Dia MS Rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately at two locations. |
| **10.00.00** | **SITE LEVELLING**<br><br>Site leveling of gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing. Bidder shall deploy adequate number of experienced site leveling contracting agency(s) with requisite earth moving and compacting equipment to complete the work as per schedule.<br><br>Bidder shall carry out the topographical survey before he commences detailed design and site leveling. This survey shall cover the entire FGD area including gypsum |

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| | storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area in Bidder's scope of work. Based on field observations the contractor shall prepare and submit for Owners review the survey maps of the surveyed sited on suitable scale, indicating grid lines, contour lines and demarcating all permanent features like roads, railways, water-ways, buildings, power lines, natural streams, trees etc. For each area two sets of survey maps shall be prepared and submitted, one showing the spot levels and contours with grid lines and the other showing the grid lines, contours and permanent features<br><br>Since the construction of roads and drains for the FGD area including gypsum storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area is included in the scope of Bidder, it shall be the responsibility of the Bidder to ensure that these facilities are also constructed along with site leveling works. Bidder shall ensure that road access and drainage facilities for each block is available when site leveling in that block is completed. Unless otherwise instructed by the Engineers, all roads and drains within a block shall be constructed by the bidder within a month from the date of completion of site leveling of that block.<br><br>The specified formation level(s) shall be achieved either by excavation where the existing ground levels are higher than the specified formation level or by raising by controlled filling with borrowed earth where the existing ground levels are lower than the specified level<br><br>All materials arising out of site clearance and excavation shall be the property of owner. They shall be dealt with in the manner specified by the Engineer. Earth / boulders / rock etc. excavated and useful portion (serviceable materials) of trees cut shall be stacked at suitable places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer. Woods, branches, trunks of trees shall be termed as serviceable material. Other materials like twigs, leaves, roots, vegetable and organic matters etc. shall be termed as unserviceable material and shall be sorted out from the serviceable materials before disposal. They shall be cleared from the area and disposed off at places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer.<br><br>If the excavated material is suitable and accepted by the Engineer as fill material, the same can be used for filling in other areas where raising by filling is required. Otherwise the same shall be taken and stacked at places(s) within the plant boundary as directed by the Engineer.<br><br>Filling with rock shall be done only after the written permission of the Engineer in the following manner:<br><br>Filling with rock shall be done only in areas identified for laydown and preassembly .<br><br>Original ground after removal of all organic and vegetable matters shall be consolidated by rolling as directed by the engineer subject to a minimum of six passes of 8-10 tonnes roller. |

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- Excavated rock shall be laid (on original ground or after filling 300 mm thick layers of soil as specified), in layers not exceeding 1000 mm and rolled with with vibratory roller (10-15 tonnes static weight) with minimum six passes.

- Over the compacted layer of rock, soil shall be filled in horizontal layers not exceeding 300mm in compacted thickness. The soil shall be compacted as specified elsewhere.

- It shall be ensured that the top soil layer is in minimum 3 layers of 300 mm each. To achieve this the thickness and number of rockfill layers below can be suitably adjusted.

Contour map and spot levels of the area based on the preliminary survey carried out by Owner is enclosed for the purpose of guidance of Bidder. However, Owner does not lake any responsibility about the accuracy of the survey details furnished and any variation of the said data shall not constitute a valid reason for changing the terms and conditions of the contract. Bidder is requested to carry out his independent assessment of the existing ground levels before furnishing his. bid Detailed survey shall be carried out by Bidder after award of work and all findings as stated earlier shall be submitted for Owner's review.

Before commencement of cutting/filling, all organic and vegetable matters like grass. Plants shrubs bushes, weeds, trees (with girth less than 30 cm measured at height of 1m above ground level) etc. in the areas to be filled, shall be completely removed along with their roots and disposed off. .It shall also be ensured that the area
to be filled is clear of any water, slush etc. Original ground shall be compacted by rolling as directed by the Engineer subject to a minimum of six passes of 8 to 10 tonne
roller The earth shall then be spread in horizontal layers not exceeding 300 mm in compacted thickness. Each layer shall be watered and compacted with proper moisture
content and with such equipment as may by required to obtain a compaction of 95% or more of Standard Proctor's maximum dry density. The moisture content of the fill
material shall be controlled to obtain near optimum moisture content during compaction.
The fill material shall be tested for determining optimum moisture content and maximum dry density by Standard Proctor Test as per IS : 2720 (Part-VII). The fill material shall also be tested for determining moisture content before compaction as per IS:2720 (Part-II) For each of the above tests, one sample for every 10,000 cubic metre of fill material shall be tested. Additional samples shall be tested, whenever there is a change in the source or type of fill material. The compacted soil shall be tested for its dry density as per IS2720 (Part-XXIX) or Part-XXVIII). Samples shall be taken at the rate of one sample for every 10,000 sq.m. area for each compacted layer. In addition random checks shall be carried out in compacted soils by means of Proctor needle penetration. Bidder shall submit to the Engineer, the test results immediately after completion of the tests. A sample shall be deemed to have passed the test when the in-situ dry density is equal to or more than the specified percentage of maximum dry density. If a sample taken from a layer fails to pass the test, the layer shall be further compacted till two samples

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taken and tested from this layer pass without any negative deviation. Only after this. spreading of further layers shall be taken up.

Before start of filling, the Bidder shall submit to the Owner his proposal for the methodology to be adopted for compaction for each type of fill material. The Bidder shall also carry out compaction trials to establish the proposed methodology. The Bidder
shall start the compaction work only after approval of the methodology by the Owner

The surface of the cut/filled up areas after reaching final level shall be dressed to the required levels and slopes. The difference in levels shall not be more than +/- 10cm
locally.

The borrow areas outside the overall plant boundary limits for obtaining suitable fill material which is required over and above the earth available after cutting high grounds
within the plant area, for site levelling shall be arranged by the Bidder himself and all
expenses in respect of royalties, taxes, duties, etc. for borrow areas/fill material shall
be borne by him. He shall also obtain and submit to the Owner the necessary clearances/permission from the concerned authorities for the borrow areas/fill material.

Material suitable for filling shall be loaded and transported to the filling site by the Bidder.
Any coarse grained or fine grained low plastic soil, free from shingle, salts, organic matter, sod or any other foreign substances, may be used for filling. The Bidder shall
test the fill material to establish its suitability and submit its results to the Owner. Fill material shall be approved by the Owner. The following types of materials shall not be used for filling:

a) Material from swamps, marshes and bogs.

b) Expansive clays

c) Peat, logs, stumps, sod and perishable materials.

d) Materials susceptible to combustion

e) Any material or industrial and domestic produce which will adversely affect other materials in the work.

f) Materials from prohibited areas

Bidder shall include in his offer any extra filling that may be required on account of subsidence of the original ground due to overburden of filling above and/or compaction works for site levelling.

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| | After levelling, the contractor shall establish concrete pillars at the intersection points of the grid lines for future reference. These pillars shall project at least 450 mm above the formation level and shall be labelled permanently with their respective coordinates and reduced levels.<br><br>Filling upto the specified formation level shall extend at least 2.0m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical:2 Horizontal) and provided with good quality dry stone pitching minimum 300mm thick for slope upto level difference of 3m. If the level difference is more than 3m, the stone pitching shall be provided with RCC bands with suitable design and benching. |
| **11.00.00** | **FENCING**<br><br>Fencing with toe wall and steel gates shall be provided around the gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas . Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. All Fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5 m c/c distance. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.<br><br>Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 2. 4) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing. |
| **12.00.00** | **ROADS**<br><br>All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to determine the modulus of sub grade reaction “K” shall be carried out as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab.<br><br>The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement. |

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| | The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete.<br><br>The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level.<br><br>The sub grade under all roads and its shoulders shall be compacted to achieve 95 per cent or more of Standard Proctor's Density MDD using mechanical means.<br><br>Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out.<br><br>All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed.<br><br>Unless otherwise specified, all roads shall be double lane roads. |
| **13.00.00** | **GATE ALONG BOUNDARY WALL:**<br>The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminum ball bearing, castor wheel etc.<br>All gates shall be given anti-corrosive treatment in three coats.<br>The structural steel shall confirm to IS: 2062 (latest) and all other relevant IS codes.<br>Beside the each gate one room of size not less than 3m X 3m shall be provided for security guards. The room shall be made of brick/ RCC and with RCC roof. In addition to the room, one toilet block shall also be provided. |
| **14.00.00** | **LIME & GYPSUM HANDLING AND ASSOCIATED BUILDINGS STORM WATER DRAINAGE SYSTEM**<br>Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided.<br><br>Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab |

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| | of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of roads .These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings.<br><br>All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.<br><br>The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions.<br><br>The invert levels of the drains shall be decided in such a way that the water can easily be discharged to the natural water bodies above the high flood. |
| **15.00.00** | **SEWERAGE SYSTEM**<br><br>The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner's sewage network is in bidder's scope.<br><br>Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas . However, for pressure pipes and under roads spun C.I. pipes conforming to IS:1536 of required class shall be used.<br><br>RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111.<br><br>Sewage pump house shall be provided as per IS:4111. |
| **16.00.00** | **LOADING** |
| **16.01.00** | For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration). Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design. The structure and equipment shall also be designed for seismic loads as per the **"Criteria for Earthquake Resistant Design of Structures and equipment"** and the **"Criteria for Wind Resistant Design of Structures and equipment"** specified in the **"Project Information section"** of technical specification. Wind and seismic forces shall not be considered to act simultaneously. The following minimum live loads shall be adopted for the design of various structures. If actual expected load is more than the specified load, then actual load is to be considered. |

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| | a ) Roofs | 150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs.<br>In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered. |
| | b ) R. C. C. floors | 500 Kgs. / Sq. M. |
| | c ) Stair and balconies | 500 Kgs. / Sq. M. |
| | d ) Toilet rooms | 200 Kgs. / Sq. M. |
| | e ) Chequered plate floors | 400 Kgs. / Sq. M. |
| | f ) Walkways ( including walkways in conveyor galleries ) | 300 Kgs. / Sq. M. |
| | g ) Conveyor galleries | In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 Kgs. / m ( minimum ) on each of the longitudinal girder.<br>Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes. |
| | h ) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches. | For class 'AA' loading and checked for class A loading as per IRC standard. |
| | i ) Channels / trenches | In addition to earth pressure and water pressure, etc. additional earth pressure due to surcharge of 2T / Sq. M. shall also be considered for design. |
| | j ) Covers for trenches / channels | Covers for channels & trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical. |

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| | k ) Sumps and tanks and other underground basement type structures — In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water pressure etc. These are also to be designed for the following conditions :<br>i ) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid ).<br>ii ) Earth with surcharge outside and no water / liquid inside<br>iii ) For underground (basement) structures protection against buoyancy during execution and after execution shall be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy. |
| | If the erection load is higher than the specified live loads on any floor or part thereof, then the erection loads are to be considered for the design.<br><br>Permissible increase in stresses of materials and bearing pressure of soil due to wind load or seismic load shall be as per relevant I. R. S. and I. S. code. |
| **16.02.00** | **Crane load**<br>For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously. |
| **16.03.00** | **Temperature load**<br>For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.<br><br>Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively. |
| **17.00.00** | **DESIGN CRITERIA** |
| **17.01.00** | The design of all R. C. C. structures shall be carried out as per ‘code of practice for plain and reinforced concrete for general building construction’, IS : 456 ( latest ). |

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| **17.01.00** | Design of steel structures shall be done by the Working stress method. Design shall be as per provisions of IS:800 :1984 and other relevant IS standards. |
| **17.02.00** | Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. Connections shall be designed for 70 % of shear capacity of the member or the actual shear force, whichever is higher. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – "Code of Practice for use of steel tubes in general building construction." and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 Mpa & 4.0mm respectively |
| **17.03.00** | The building shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41. |
| **17.04.00** | Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports. |
| **17.05.00** | Stresses for all structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method. |
| **17.06.00** | Horizontal bracing system shall be provided at floor levels around the openings. |
| **17.07.00** | Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement. |
| **17.08.00** | For design of liquid retaining structures, IS : 3370 ( Part - I to IV ) ( latest ) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed. |
| **17.09.00** | For design of all underground structures / foundations, ground water table shall be assumed at the formation level ( i. e. the adjoining ground level ). For all underground structures like tunnel, underground transfer point and underground hopper etc. crack width shall be limited to 0.2mm. |
| **17.10.00** | Design of masonry walls shall be made as per IS : 1905. |
| **17.11.00** | Civil task drawing indicating various equipment loading and supporting arrangement and floor loads to be submitted along with the design calculation. |
| **17.12.00** | Minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456. |
| **17.13.00** | Foundations for all tanks shall be designed for as per IS: 803. |
| **17.14.00** | Footings shall be so proportioned to as to minimise the differential settlement. |
| **17.15.00** | All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. This deflection condition shall be strictly followed. Peak wind speed method shall be considered for checking the transverse deflection. |

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| **17.16.00** | The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles. |
| **17.17.00** | **Deflection criteria**<br>The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following: |

| Sl. No. | Description | Maximum value of |
|---|---|---|
| 1. | For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level) | Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load) |
| 2. | For other Buildings | Height/325 |

| | | |
|---|---|---|
| **17.18.00** | a) | Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325. |
| | b) | The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification. |
| | c) | The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500.<br>For electric overhead cranes :<br>1) upto 50 t capacity : span/750<br>2) over 50 t capacity : span/1000 |
| | d) | The vertical deflection of metal deck sheet for roofing and side cladding shall be limited to span/250 |
| | e) | The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325. |
| | f) | Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm. |
| 17.19.00 | a) | Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part). |
| | b) | Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area. |
| 17.20.00 | a) | The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever |

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| | specifically mentioned in this specification.<br>b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed.<br>c) For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.<br>d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more. |
| 17.21.00 | a) All RCC liquid retaining/conveying shall be designed by working stress method as outlined in clause no. 4.5 of IS 3370 (Part-2) 2009 unless specified other wise.<br>b) Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be provided with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m.<br>Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work.<br>c) All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles. |
| **17.22.00** | For design of all underground structures, foundations, etc. ground water table shall be assumed at the finished ground level unless specified otherwise. |
| **17.23.00** | Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding. |
| **17.24.00** | a) Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid<br>i) Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)<br>ii) Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside. |

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| | iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy unless specified otherwise.<br>iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level.<br>b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance.<br>c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads. |
| **17.25.00** | **Design of Block Foundation**<br>a) Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied.<br>Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV).<br>b) For the foundations supporting minor rotating equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably. |
| **18.00.00** | **Coating on RCC water retaining structures (other than drinking water)**<br>Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below:<br>All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free.<br>Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. |

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| | **Coating on RCC water retaining structures (drinking water)**<br>Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free |
| . | |
| **19.00.00** | **Fabrication** |
| | All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.<br><br>Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded. |
| **20.00.00** | **Electrodes** |
| 20.01.00 | The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium /high tensile steel and for mild steel plate thickness above 20 mm. |
| 20.02.00 | All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use. |
| 20.03.00 | Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage. |
| 20.04.00 | Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing. |
| 20.05.00 | Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated. |
| 20.06.00 | The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started. |
| **20.07.00** | **Edge Preparation for Welding**<br><br>Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded. |
| **20.08.00** | **Pre Heating and Post Heating**<br><br>Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature |

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may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.

Base metal shall be preheated, not withstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat and this temperature shall be maintained as minimum inter-pass temperature welding is in progress.

**TABLE - 1**
**MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL**

| | Welding Using | |
|---|---|---|
| **Thickness of thicker part at Point of welding** | **Low hydrogen electrode or submerged arc welding** | **Other than low hydrogen electrode** |
| Upto and including 20mm | None | None |
| Over 20mm and up to and including 40mm | 20°C | Not allowed |
| Over 40mm and up to and including 63mm | 66°C | Not allowed |
| Over 63mm | 110°C | Not allowed |

Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.

**TABLE - 2**
**MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL**

| | Welding Using | |
|---|---|---|
| **Thickness of thicker part at Point of welding** | **Low hydrogen electrode or submerged arc welding** | **Other than low hydrogen electrode** |
| Upto and including 20mm | None | Not Allowed |
| Over 20mm | 120oC - 140°C | Not Allowed |

Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.

20.09.00 Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the

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| | surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained. |
| 20.10.00 | Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature. |
| 20.11.00 | All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600oC and rate of application shall be 200oC per hour. |
| 20.12.00 | The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas. |
| **21.00.00** | **Paving, Drainage and Sewage** |
| | RCC paving of minimum 150 mm thick with M25 grade concrete, over an underbed as specified herein shall be provided. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving with 63 mm and down aggregate with interstices filled with selected moorum followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification.<br><br>2.5 m wide paving with metallic hardener around periphery of all sumps and underground tanks shall be provided.<br><br>Suitable drains shall be provided to dispose off storm water as well as floor wash of the FGD area block. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.<br><br>Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD area to the nearest available manhole of the owner.<br><br>The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings.<br><br>Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec. |
| **22.00.00** | **Statutory Requirements**<br><br>Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc. |

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| | Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc.<br><br>Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tarrif Advisory Committee.<br><br>Statutory clearances and norms of State Pollution Control Board shall be followed.<br><br>Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work. |
| **23.00.00** | **INSPECTION, TESTING AND QUALITY CONTROL**<br><br>Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used.<br><br>The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction. |
| **24.00.00** | **CONCRETE**<br><br>All R. C. C. works to the done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows:<br><br>a ) M25 - For all underground / sub-structural/ super-structure R. C. C. work.<br><br>b ) M30- For Block Foundation<br><br>c) M35- For spring supported RCC deck<br><br>Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations.<br><br>For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix.<br><br>Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned. |

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| **25.00.00** | **Excavation, Backfilling, Disposal and Stacking of materials Details** |
| **25.01.00** | **Excavation in Soil**<br><br>Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error, it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates ), as directed by the Engineer.<br><br>The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer.<br><br>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer.<br><br>The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose.<br><br>For other details, excavation clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification, are to be referred. |
| **25.02.00** | **Excavation in Rock**<br><br>For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency.<br><br>Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed.<br><br>The contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per Explosives Act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive materials.<br><br>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. For other details for excavation in rock, clauses as given at |

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| | "Foundation system and Geotechnical Data Chapter" given at "Project Information section" of Technical specification, are to be referred. |
| **25.03.00** | **Backfilling, Disposal and Stacking of materials**<br><br>Backfilled earth shall be compacted as per "Foundation system and Geotechnical Data Chapter" given at "Project Information section" of technical specification.<br><br>However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities.<br><br>The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer.<br><br>The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below:<br><br>The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes.<br><br>For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer.<br><br>Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose.<br><br>Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the material is mostly rock boulders, these shall be broken into pieces not larger than 150 mm size before backfilling and shall be backfilled in layers of 300mm interstices filled with sand. In case of broken rock boulders used for back filling, the top cover shall be with 1.0m thick soil. The layers of rock boulders, interstices filled with sand shall be compacted by plate vibrators. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer. |

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| | In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be pain for utilisation of borrow areas. |
| **26.00.00** | **GALVANISING**<br><br>All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising.<br><br>Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 ( latest edition ).<br><br>The weight of the zinc coating shall be at least 610 Gms. / $m^2$ unless noted otherwise. |
| **27.00.00** | **CHEMICAL INJECTION GROUTING**<br><br>Minimum, 12 mm dia ( NB ) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete.<br><br>For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using repercussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes.<br><br>After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / $cm^2$. Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer. |

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| **28.00.00** | **POLYMER MODIFIED CEMENTITIOUS COATING** |
| **28.01.00** | **Materials**<br><br>Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%).<br><br>Portland cement based dry powder.<br><br>Clean, fine specially prepared quartz sand approximately 0.6 mm size. |
| **28.02.00** | **Mixing**<br><br>The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same. |
| **28.03.00** | **Properties of Coating**<br><br>It must adhere to wet surface.<br><br>It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm.<br><br>Co - efficient of permeability shall be about $5x10^{-10}$ Cm / Sec.<br><br>Water absorption after continuous soaking shall not be more than 1 %.<br><br>The materials shall be permeable under water vapour.<br><br>The material shall be resistant to acids and alkalies present in the soil and underground water with normal pH value between 4 and 14.<br><br>The co - efficient of thermal expansion of the material shall be close to that of concrete. |
| **28.04.00** | **Application**<br><br>The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed.<br><br>**(a) For Slurry Mix**<br><br>A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry |

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| | sponge. The coverage shall not be less than 1 : 1 Kgs. / $m^2$ in the 2 coats. A lap of 75 mm shall be provided at the joints.<br><br>The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat.<br><br>**(b) For Brush Topping Mix**<br><br>This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any.<br><br>The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat.<br><br>Rate of application of coating shall be established to achieve the required thickness. |
| **29.00.00** | **Architectural Concepts**<br><br>Buildings shall be architecturally treated in such a way that it presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehensive scale, blending with the surroundings and taking full consideration of the climatic conditions and the building orientation. All the buildings shall be architecturally treated in such a way so as to be in harmony with the surroundings. The over all composition may have straight or curvilinear profiles.<br><br>Necessary projections, fins, parapets, chajjas etc. in addition to the minimum area specified elsewhere in this specification shall be provided as required.<br><br>Nothing extra shall be payable for any changes required while getting the drawings / scheme approved and for executing the same.<br><br>All structures, buildings and facilities shall be designed as per provisions of National Building Code 2005 and Local building by - laws as applicable including provisions of the Factories Act of the State concerned, with regard to requirement of free access, stairs, minimum head room, walkways, ventilation, toilets etc. and safety requirements like railings, fire escapes etc. Further all layouts and detailed drawings shall meet the relevant statutory requirements specified in recommendations of Petroleum act, Explosives act and Indian Electricity rules' as applicable. |
| **29.01.00** | **FINISHING SCHEDULE** |
| **29.01.01** | **Flooring**<br><br>The nominal total thickness of floor finish shall be 50mm i.e. underbed & topping. The floor shall be laid on an already laid and matured concrete base. |

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| | Flooring of tiles / stone shall be fixed with 18 mm thk cement sand mortar 1:4, above PCC under bed (M 20 (with graded aggregate of nominal size 12.5mm) design mix)<br><br>Flooring of Concrete hardener topping shall be provided above the PCC underbed (M 20 (with graded aggregate of nominal size 12.5mm) design mix). |
| **29.01.02** | Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer (Kajaria, Orient, Johnson or equivalent) of approved finish shade and colour to be used. Vitrified ceramic tiles wherever specified shall be 600x600 mm with minimum 9.5 mm thickness and of reputed manufacturer (Kajaria, Johnson, Orient or equivalent). |
| **29.02.00** | **Floor finish & skirting:**<br><br>The nominal thickness of floor finish shall be 50 mm.<br><br>Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7 mm thick as per IS:15622, including pointing the joints with white cement mixed with matching pigment, of approved make, size & colour shade.<br><br>(1) Floors of Office Room, Labs, Control Rooms, RIO Rooms and all other A/c Room shall be finished with Mirror polished Vitrified ceramic tiles ( minimum 9.5 mm thk) with 3 mm groove joints as per approved pattern, pointed neatly with 3X4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile.<br><br>(2) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Control rooms for mounting Control panels / MCC.<br><br>(3) In rest of the areas, IPS (Cement concrete flooring) with Concrete hardener topping shall be 12mm thick with ordinary grey cement using uniformly graded, properly treated iron particles shall be provided.<br><br>(4) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting.<br><br>(5) The interconnecting walkway between various structures, buildings and facilities shall be finished with 22 mm chequered concrete tiles at top. 1000 mm wide walkway of 22mm thick chequered concrete tiles shall be provided on terrace for maintenance purpose, in all RCC /Metal deck roof buildings.<br><br>(6) Skirting in general shall be 150mm high, Dado in toilet, kitchen & pantry shall be up to specified height (up to 2200 mm for toilets, up to 600 mm high above counter top in kitchen and pantry area). The dado height shall be measured from finished floor level. Skirting and Dado shall match with the floor finish.<br><br>(7) Battery Room shall be provided with Acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works, including One coat of bitumen primer followed by 12 mm thick bituminastic layer, 20 mm thick Acid Resistant tiles, 6 mm thick under-bed by potassium silicate mortar, 6 mm thick pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar up |

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| | to a depth of 20 mm and bituminastic end sealing. 1200 mm high dado on wall shall be with 12 mm thk Acid resistant tiles of the similar finish and the joints to be finished as per flooring tiles, with the rest of wall height and ceiling finished in chemical resistant paint (chlorinated rubber based).<br>(8) Well polished 18 mm thick Kota stone jointed with neat cement slurry mixed with pigment to match the shade of the stone including rubbing and cleaning, complete, to be provided in entrance area, entrance steps, Entrance area, staircases (tread, riser, landings, skirting). |
| **29.03.00** | Sunken RCC slab shall be provided in false flooring area and toilet, Kitchen and pantry, so as to keep the finished floor level of these areas same as that of the surrounding area. |
| **29.04.00** | Water proofing treatment to be provided on sunken portion of all vertical and horizontal surfaces of depressed portions of all toilets, W.C., kitchen, Pantry and the like consisting of :<br>(i) Ist course of applying cement slurry @ 4.4 kg/sq.m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.<br>(ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.<br>(iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area.<br>(iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m). |
| **29.05.00** | **Acid / Alkali Resistant Treatment:**<br>Acid / alkali resistant lining treatment shall be provided in different areas as follows:<br>Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable plasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification.<br>The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.tile layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted.<br>The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron).<br>Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. : The floor shall be provided with one coat of bitumen primer followed |

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| | by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 12 mm thk Acid Resistant tiles up to 1.0M high shall also be provided if applicable in case of walls nearby.<br><br>Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing.<br><br>Alum solution preparation tank:<br><br>The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing.<br><br>The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer.<br><br>Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer.<br><br>Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks.<br><br>Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns.<br><br>Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns. |
| **29.06.00** | **Walls** |
| **29.06.01** | All walls shall be non-load bearing infilled panel walls. All external walls shall be minimum one brick thick masonry wall. |
| **29.06.02** | All external and internal walls shall be with minimum one brick masonry (230 or 250 mm) including toilet walls. Toilet partition low height walls shall be minimum half brick masonry. |
| **29.06.03** | For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230m thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered & painted as specified elsewhere in the specification. |
| **29.06.04** | RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork. |
| **29.06.05** | 50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/ sq.m. shall be provided at plinth level before starting the masonry work. |

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| **29.06.06** | The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction. |
| **29.07.00** | **Plastering** |
| **29.07.01** | External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4).<br>The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6).<br>All external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc. |
| **29.07.02** | All exposed faces of R.C.C. walls of structures, buildings and facilities shall have minimum 12 mm thick cement sand plaster 1:6. |
| **29.07.03** | All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4. |
| **29.07.04** | All plastering work shall conform to IS: 1661. |
| **29.08.00** | **Painting** |
| **29.08.01** | All painting on masonry or concrete surface shall preferably be applied by roller. If<br>Applied by brush then same shall be finished off with roller. |
| **29.08.02** | All paints shall be of approved make including chemical resistant chlorinated rubber paint. |
| **29.08.03** | Minimum two finishing coats of paint shall be applied over a coat of primer. |
| **29.08.04** | The thinner shall not be used with textured paint (Sandtex Matt or equivalent) finish. |
| **29.09.00** | **Internal Finish**<br>All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface. |
| **29.09.01** | Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428. Air - conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint. All other areas shall be applied with minimum 2 coats of Acrylic distemper. |
| **29.09.02** | Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x200mw (matt finish) upto 2.2 m height and shall match with floor finish. Above dado, Acrylic distemper shall be applied. |
| **29.09.03** | Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado & ceiling.<br>The paint shall be of approved colour shade and make. |
| **29.10.00** | **External Wall Finish**<br>One pack, ready mix and ready to use, resin / polymer bonded granular textured coating finish of 2.5 mm (natural coloured graded stone chips ), of approved colour, and shade for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, preparation of working drawing, |

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| | labour, material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc., all complete, as per specifications, drawings and instructions of the Engineer-in-charge.<br><br>Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint<br><br>The finish shall be of approved colour shade and make. |
| **29.11.00** | **Ceiling Finish**<br><br>Ceiling shall have min. two (2) coats of Acrylic distemper except AC areas & Battery room. |
| **29.11.01** | For painting on concrete, masonry and plastered & surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed. |
| **29.11.02** | Fire resistant transparent paint (confirming to IS: 162 ) shall be provided on all wood work, over French police or flat oil paint. French polish shall confirm to IS : 348. Flat oil paint shall confirm to IS: 1237. |
| **29.12.00** | **Doors, Windows, Ventilators, Louvers, Rolling Shutters & Glazing** |
| **29.12.01** | Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top. |
| **29.12.02** | Unless specified all doors, of air conditioned areas, entrance lobby of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. Windows, ventilators & partitions of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-II) with pressed steel door frame. Control room shall have Aluminium glazed door & partitions. All other doors (unless otherwise specified) shall be of steel. |
| **29.12.03** | All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc. |
| **29.12.04** | Wherever functionally required, rolling shutters of suitable size approved by the Owner, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248. |
| **29.12.05** | All windows and ventilators at ground floor level shall be provided with suitable anodised aluminum grill. |
| **29.12.06** | Fire proof doors with panic devices shall be provided at all fire exit points as per the requirements. However minimum Fire rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation. |
| **29.12.07** | Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL, Jindal, Hindalco or equivalent shall be used for all Aluminium doors, windows, ventilators and Partitions. |

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| **29.12.08** | The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thk clear toughened glass for all glazed doors, windows, ventilators & partitions. Windows in air conditioned areas shall be provided with 24mm thick hermetically sealed composite double glazing. |
| **29.12.09** | Doors and windows on external walls shall be provided with sunshade over the openings with width 600 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings, 750 mm over door openings and 900 over Rolling shutters, or as decided and approved by the Engineer. |
| **29.12.10** | Float glass or flat transparent sheet glass shall conform to IS: 2835. |
| **29.12.11** | All glazing work shall conform to IS: 3548. |
| **29.12.12** | Windows in conveyor gallery shall be provided with welded wire fabric of 1.6mm thick wire as per IS: 4948 and 12mm x 30mm mesh size. |
| **30.00.00** | **WATER SUPPLY, DRAINAGE AND SANITATION** |
| **30.01.00** | Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet, pantry and kitchen) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be calculated minimum 500 liters, per toilet, pantry and kitchen |
| **30.02.00** | Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for potable water supply. |
| **30.03.00** | Sand C.I. pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level. |
| **30.04.00** | The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed. |
| **30.05.00** | Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type).<br>The common toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area.<br>Following minimum fittings & fixtures together with associated plumbing works shall be provided as specified below. |

| **Sl. No.** | **Type of Fitting / Fixtures** | **Gents Toilet** |
|---|---|---|
| i) | 1 no wall mounted coloured glazed vitreous china European water closet with flush valve. | 1 No. |
| ii) | Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures | 1 |
| Iii) | Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first | 1 No. |

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| | grade polished granite stone | |
| iv) | Wall to wall mirror minimum 450 mm high (minimum 6mm thick float glass) including all fittings | 1 No. |
| v) | Stainless steel Towel Rail 600mm Long x 20 mm dia. | 1 No. |
| vi) | Stainless steel Liquid soap holder cum dispenser with requisite fittings. | 1 No. |
| vii) | Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type. | 1 |
| viii) | Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type | 1 No. |

One No. drinking water connection with C.P. brass valve for fixing water cooler by Owner.

Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above.

Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers.

Janitor room. Adequate space shall be provided.

Provision for installation of water cooler.

**30.06.00** All structures, buildings, facilities, liquid storage tanks shall be provided with peripheral surface brick drains of all around periphery and suitably connected to nearest Owner's drain. Overflow and drains from storage tanks shall be laid to and suitably connected to Owner's open surface drains.

**30.07.00** The sewerage and waste water disposal system shall consist of providing all associated plumbing and underground pipe works together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers, including connection to Owner's nearest main sewer line or as directed by Engineer. If required, R.C.C. septic tank and soak pit of required capacity shall be provided by the Bidder.

**30.08.00** Miscellaneous Architectural Items

(a.) In all buildings suitable arrangement with provision of floor traps for draining the water collected from leakage, floor washing, fire fighting etc. shall be provided on all floors which shall be connected to rain water down comers.

(b.) Wherever required minimum 1000 high hand railing with 32 NB M.S. pipes medium class as per IS : 1239 shall be provided, with toe & knee rail and toe guard plate, around all floor / roof openings, around periphery of Neutralisation Pit, projections of balconies, walkways, platforms, steel staircase etc.

(c.) However for RCC staircases in structures, buildings and facilities, railings with 20 mm square MS bar balustrades with suitable anti corrosive paint of approved colour MS flats for knee & toe guard with 50mm Ø NB MS pipe hand rail at top shall be provided.

(d.) All air conditioned areas / common corridors shall be provided with false ceiling constructed from 15 mm mineral Fibre Board in tile form of

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| | 600x600mm with supporting system as per manufacture guidelines. 50 mm thick mineral wool insulation (conforming to IS : 8183) shall be provided with as under deck insulation). Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, Air conditioning ducts etc. Minimum headroom below false ceiling shall be 3.0 m. |
| | (e.) Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil & 24 G x 25 mm mesh wire netting and shall be fixed to ceiling with 24 G wire ties and suitable fixing arrangements. |
| | (f.) Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3 ). |
| | (g.) 150mm thick fillets at junction of roof slab / chajja slab and parapet / vertical walls shall be provided with cast - in - situ cement concrete 1 : 2 : 4 nominal mix, followed by 12 mm thick cement sand plaster (1 : 4). |
| | (h.) Suitable provision shall be made for fixing of ceiling fans in office areas of different structures, buildings and facilities. |
| **31.00.00** | **CORROSION PROTECTION** |
| 31.01.00 | GENERAL |
| | (a) All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category C3 (durability High) as per ISO 12944. |
| | Painting system for steel surfaces embedded in Concrete is given separately. |
| | (b) All Painting shall be done as per technical specification. Painting scheme shall be submitted by the bidder for approval of employer. |
| | (c) All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance of 1.5 mm shall be kept in thickness(over the design thickness) of structural steel members. |
| | d) Painting scheme shall be resubmitted by the Bidder for approval of employer. |
| 31.02.00 | PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE: |
| | a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT). |
| | b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents. |
| 31.03.00 | PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN CONCRETE) |

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| | a) All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.<br><br>b) Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.<br><br>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 $\Delta$E) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.<br><br>Notes:<br><br>1. For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time.<br><br>2. The most frequent problem associated when top coating Primer is bubbling/pin holing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required.<br><br>3. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required.<br><br>4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme. |
| 31.04.00 | **COATING FOR MILD STEEL PARTS IN CONTACT WITH WATER.**<br><br>a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / Sq. M. for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629. |

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| | b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified. |
| 31.05.00 | **Gratings**<br>All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 Gms / Sq. M. |
| 31.06.00 | **Hand Railings and Ladders**<br>All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0. |
| 31.07.00 | **Sea Worthiness**<br>All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness. |
| 31.08.00 | **For Reinforced Concrete Work.**<br>i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts.<br>ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion.<br>This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc.,<br>Bidder shall furnish the details of corrosion protection measures. |
| **32.00.00** | **Miscellaneous** |
| **32.01.00** | Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings. |
| **32.02.00** | Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders. |
| **32.03.00** | Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided. |
| **32.04.00** | Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / $mm^2$ unless higher strength requirement is specified by the equipment supplier or the grout manufacturers. |

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| **32.05.00** | The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground. |
| **32.06.00** | Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines. |
| **33.00.00** | **SHOTCRETING** |
| **33.01.00** | **General Requirements** |
| **33.01.01** | Generally, shotcreting shall be done in accordance with IS : 9012. |
| **33.01.02** | Reinforcement for shotcreting shall be as detailed below, unless specified otherwise.<br><br>Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting. |
| **33.01.03** | Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied. |
| **33.01.04** | Clear cover to reinforcement mesh shall not be less than 15 mm. |
| **33.01.05** | Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work. |
| **33.02.00** | **Material**<br><br>Generally, the materials shall be in accordance with aggregates specification given hereunder. |
| **33.02.01** | Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383. |
| **33.02.02** | Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012. |
| **33.02.03** | The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer. |

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| **33.03.00** | **Application** |
| **33.03.01** | After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting. |
| **33.03.02** | The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required. |
| **33.03.03** | A uniform pressure of not less than 3 $Kg/cm^2$ at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine. |
| **33.03.04** | The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused. |
| **33.03.05** | As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed $38^0C$ during placing of concrete. |
| **34.00.00** | **VIBRATION ISOLATION SYSTEM**<br><br>These specifications are meant for the design, supply and erection of vibration isolation system for supporting crushers. |
| **34.01.00** | **Supporting Arrangement** |
| **34.01.01** | **For Crushers:**<br><br>The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building.<br><br>The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”. |

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| **34.01.02** | The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for at least five years. |
| **34.02.00** | **Scope of Work** |
| **34.02.01** | Scope of work shall include the following :<br><br>(a.) Engineering<br><br>(1.) Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the equipment. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the equipment.<br><br>(2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc.<br><br>(3.) Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure.<br><br>(4.) Drawings showing embedments and their locations and details on the R. C. C. top deck.<br><br>(5.) Drawings showing blockouts, recesses etc. on the top deck.<br><br>(6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials.<br><br>**(b.) Supply including packing and transportation to site**<br><br>(1.) Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.<br><br>(2.) Frame ( s ) for pre-stressing of spring elements.<br><br>(3.) Suitable hydraulic jacks system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required. |

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| | **(c.) Erection and Commissioning**<br><br>(1.) Complete erection and commissioning of the vibration isolation system including :<br><br>(2.) Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc.<br><br>(3.) The scope of work shall be deemed to include all activities which may not have been explicitly mentioned but are reasonably implied for the successful completion of the work for which these specifications are intended.<br><br>(4.) This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to.<br><br>**(d.) Documentation**<br><br>(1.) Submission of detailed design calculation, analysis ( static and dynamic ) and drawings for Employer's acceptance and approval.<br><br>(2.) Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation.<br><br>(3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system.<br><br>(4.) Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation.<br><br>(5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.<br><br>(6.) Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform.<br><br>(7.) Proposed erection strategy of the entire system. |
| **34.03.00** | **Design Requirements for Crusher Foundation** |
| **34.03.01** | **Dynamic Analysis**<br><br>Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be |

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| | determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis.<br><br>Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria.<br><br>Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor. |
| **34.03.02** | **Isolation Efficiency**<br><br>The vibration isolation system shall be designed for about 90 % isolation efficiency. |
| **34.03.03** | **De-coupling**<br><br>A ratio of the least 10 ( ten ) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two ( the stiffness of the spring system being lower ). This ensures that dynamic analysis of the supporting structure need not be carried out. |
| **34.03.04** | **Frequency Criteria**<br><br>The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required.<br><br>The first bending mode frequency of the top deck shall be at least 20 % above the operating speed. |
| **34.03.05** | **Unbalance Forces for Crushers**<br><br>Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes.<br><br>(a.) Balance quality grade Q 40 as per VDI 2060 - 1966.<br><br>(b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher.<br><br>(c.) Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher. |
| **34.03.06** | **Amplitude Criteria for Crushers**<br><br>The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions. |

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| | 1) Operating speed of 750 RPM<br><br>(a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966.<br><br>(b.) 300 microns in case of a one hammer broken condition.<br><br>(c.) Amplitudes need not be checked for a three hammer broken condition.<br><br>2) Operating speed of 450 RPM<br><br>(a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966.<br><br>(b.) 400 microns in case of a one hammers broken condition.<br><br>(c.) Amplitude need not be checked for a three hammer broken condition.<br><br>For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated.<br><br>The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vetor may be considered while superimposing the modes. |
| **34.03.07** | **Unbalance force and Amplitude Criteria**<br><br>The unbalance forces and amplitude criteria shall be as per the equipment manufacturer's recommendations or as per VDI 2060/ VDI 2056, whichever is more stringent. |
| **34.03.08** | **Transient Resonance**<br><br>Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition. |
| **34.04.00** | **Strength Criteria**<br><br>The following criteria shall apply for the design of top deck :<br><br>(a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design.<br><br>(b.) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together |

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| | (c.) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design.<br><br>(d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted.<br><br>(e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456.<br><br>(f.) Fatigue need not be considered for the three hammer broken condition.<br><br>(g.) For calculating unbalance forces, the heaviest hammer ( plain or toothed ) shall be considered. |
| **34.05.00** | **Approval of Designs and Drawings**<br><br>All design calculation, drawings and documents shall be in English. All design calculations and drawings shall be submitted to Employer for approval. However, approval of such designs and drawings shall not relieve the contractor of his responsibility regarding the adequacy of the foundation to carry the design forces. |
| **34.06.00** | **Standards**<br><br>Latest revisions of the following Codes shall be used for the design of the crusher foundations.<br><br>(a.) IS : 456 Code of Practice for Plain and Reinforced concrete.<br><br>(b.) IS : 2974 ( Part IV ) Code of Practice for Design and Construction of Machine Foundations ( Part IV ) for rotary type machine of low frequency.<br><br>(c.) IS : 1893 ( Criteria for Earthquake Resistant Design of Structures ).<br><br>(d.) DIN 4024 Machine Foundations :<br><br>Flexible supporting structures for machines with rotating masses.<br><br>(e.) DIN 2089<br><br>Helical Compression Springs out of round wire and rod; calculation and Design.<br><br>(f.) DIN 2096<br><br>Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs.<br><br>(g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines.<br><br>(h.) VDI 2060 - Criteria for assessing the state of balance of rotating rigid bodies.not be permitted to exceed 38$^{o}$C during placing and curing |

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| **35.00.00** | **Packaging and Transportation.**<br><br>All the equipment shall be suitably protected coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials the limitations from the point of view of availability of railway wagon sizes in India should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. |
| **36.00.00** | **Plant Life**<br><br>The plant shall be designed for a minimum operating life of 30 years under the conditions of operation. Assurance shall be given that plant components are adequate for this lifetime. If there are any exceptional items of the plant on which an assurance of meeting this clause cannot be given, life of such components and the difficulties associated with them shall be stated. |
| **37.00.00** | **PTFE (Poly Tetra Fluoroethylene) Bearing**<br><br>The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm. |
| **38.00.00** | **TESTS FOR MATERIAL / WORKMANSHIP**<br><br>All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost. |
| **39.00.00** | **MATERIALS** |
| **39.01.00** | **For Civil, Structural and Architectural works**<br><br>Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification.<br><br>The contractor shall keep sufficient stock of cement and steel at site at any point of time when the work is in progress excluding what has been already incorporated in the works, so that any disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less then the Requirement of one ( 1 ) month in case of Cement and Requirement of two ( 2 ) Consecutive months in case of Steel. |

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| **39.02.00** | **Structural steel**<br><br>Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below. |
| **39.02.01** | **Mild Steel**<br><br>a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.<br><br>b) Pipes shall conform to IS 1161.<br><br>c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240.<br><br>d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only. |
| **39.02.02** | **Medium and High Tensile Steel**<br><br>Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2. |
| **39.03.00** | Fly ash based Portland pozzolona cement conforming to IS: 1489 Part - I shall preferably be used. However, the contractor may use other types of cements conforming to IS: 269, IS: 8112, IS: 12269, & IS: 455. |
| **39.04.00** | **Reinforcement steel shall conform to:**<br><br>a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062.<br><br>b) High yield strength deformed TMT steel bars of grade Fe-500 having minimum elongation of 14.5 % or Fe-500D, and conforming to other requirements of IS 1786. |
| **40.00.00** | **CODES AND STANDARDS**<br><br>All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. Other Indian, foreign Codes and Standards not listed here but referred to elsewhere within this specification shall also be deemed to be part of this list.<br><br>In case of conflict between this specification and those (IS standards, codes etc.) referred to herein, the former shall prevail. |

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Some of the relevant Indian standards, Acts and Codes applicable to this section of the specification are listed below

| | |
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| IS : 383 | Specification for coarse and fine aggregates from natural sources for Concrete. |
| IS : 432 | Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement. |
| IS : 456 | Code of practice for plain and reinforced concrete. |
| IS : 458 | Specification for concrete pipes. |
| IS : 516 | Method of test for strength of concrete. |
| IS : 800 | Code of practice for use of structural steel in general building construction. |
| IS : 814 | Specification for covered electrodes for metal arc welding for weld steel. |
| IS : 816 | Code of practice for use of metal arc welding for general construction. |
| IS : 817 | Code of practice for training and testing of metal arc welders. |
| IS : 875 (Pt. I to V) | Code of practice for design loads other than earthquake) for buildings and structures. |
| IS : 1038 | Steel doors, windows and ventilators. |
| IS : 1172 | Basic requirements for water supply, drainage and sanitation. |
| IS : 1361 | Steel windows for industrial buildings. |
| IS : 1786 | Specification for high strength deformed steel bars and wires for concrete reinforcement. |
| IS : 1892 | Code of practice for subsurface investigation for foundation. |
| IS : 1893 | Criteria for earthquake resistant design of structures. |
| IS : 1904 | Code of practice for design and construction of foundations in soils; general requirements. |
| IS : 1905 | Code of practice for structural safety of buildings - Masonry walls. |
| IS : 1948 | Specification for aluminium doors, windows and ventilators. |
| IS : 2062 | Steel for general structural purposes. |

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| IS : 2131 | Method of standard penetration test for soils. |
| IS : 2212 | Code of practice for brickwork. |
| IS : 2645 | Specification for Integral cement water proofing compounds. |
| IS:2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) | Methods of test for soils - determination for water content etc code of practice for earth work on canals. |
| IS : 2911 | Code of practice for design and construction of pile foundations. |
| (Part-1/Sec.1) | Driven cast in situ concrete piles. |
| (Part-1/Sec.2) | Bored cast-in-situ concrete piles. |
| (Part-IV) | Load test on piles. |
| IS : 2974 (Part - I TO V) | Code of practice for design and construction of machine foundations. |
| IS : 3370 (Part I to IV) | Code of practice for concrete structures for the storage of liquids. |
| IS : 3658 | Code of practice for liquid penetrant flaw detection. |
| IS : 3664 | Code of practice for ultra sonic testing by pulse echo method. |
| IS : 4326 | Code of practice for earthquake resistant design and construction of buildings. |
| IS : 4990 | Specification for plywood for concrete shuttering work. |
| IS : 5624 | Specification for foundation bolts. |
| IS : 7215 | Tolerances for fabrication steel structures. |
| IS : 8112 | Specification for 43 grade Ordinary Portland Cement. |
| IS : 9103 | Specification for admixtures for concrete. |
| IS : 9595 | Code of procedure of manual metal arc welding of mild steel. |
| IS : 10262 | Recommended guidelines for concrete mix design. |
| IS : 13311 | Method of non - destructive testing of concrete. |
| IS : 13755 | Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a) |

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| ASTM 898 -89 | Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course. |
| AS/NZS 2728 | Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements. |
| AS : 1365 | Standards for steel manufacturing. |
| AS : 1397 | A steel sheet & strip – hot – dipped-zinc-coated or Aluminium-Zinc coated. |
| AS : 3566 | Self drilling screws for building and construction industry. |
| IRC : 37 | Guidelines for the design of flexible pavements. |
| - | Manual on sewerage and sewage treatment (Published by CPH & EEO) As updated. |

Indian Explosives Act. 1940 as updated.

**For "Foundation System and Geotechnical Data" refer "Project Information section" of Technical specification.**

# NTPC Limited

(A Government of India Enterprise)

# LOT 1A PROJECTS

# PART – B
# (DETAILED TECHNICAL SPECIFICATION)

# SUB-SECTION-I-M
# (MECHANICAL SYSTEM)

# SECTON – VI

## TECHNICAL SPECIFICATION

## FOR

## FLUE GAS DESULPHURISATION (FGD)

## SYSTEM PACKAGE

**BIDDING DOCUMENT NO. : CS-0011-109(1A)-2**

# PART – B (DETAILED TECHNICAL SPECIFICATION)

# SUB-SECTION-I-M (MECHANICAL SYSTEM)

# SUB-SECTION-I-M1

# FLUE GAS DESULPHURISATION SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

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**FLUE GAS DESULPHURIZATION (FGD) SYSTEM**

**1.00.00 GENERAL**

The design/specifications/sizing of various plants/systems/equipment offered for Flue Gas Desulphurisation (FGD) System shall comply with the requirements detailed hereinafter:

1.01.00 **System Description**

The Flue Gas Desulphurisation (FGD) System shall be based on Wet Limestone Forced Oxidation process. The FGD system shall be installed downstream of the Induced Draft (ID) fans (Employer's scope).The flue gas shall be drawn from air preheater outlets of the balanced draft, pulverised coal fired Steam Generator and guided through adequately sized duct work into the specified number of independent gas streams of each Electrostatic Precipators. The flue gas after the Electrostatic Precipitators shall be led to the suction of the ID fans. The flue gas temperature may approach the economiser outlet temperature of about 300°C in case the regenerative airpreheaters fails to operate. The Contractor shall take this aspect into account while designing the Flue Gas Desulphurisation (FGD) System.

1.02.00 **Service Conditions**

The Steam Generators, being provided by Employer, are designed to burn pulverised coal having properties as indicated in Sub-section-II-A (Project Information), Part-A, Section-VI. Also HFO/HPS/LSHS and LDO shall be used during startup and at low loads for warm up and flame stabilization as specified in respective Project Information Chapter. The design of Steam Generator shall not call for any oil support for flame stabilization beyond 40 % BMCR load when firing any coal. Further, the frequency and duration for startup and low loads operation may be quite long during the first year of unit commissioning and operation. The Steam Generator has been designed for cyclic/two shift operation. Expected numbers of Steam Generator start-ups during 25 years of design life are as follows:

| | **Type of Starts** | **Number of Starts** |
|---|---|---|
| | | |
| a. | Hot start (after 8 hours of unit shut down) | **4000** |
| | | |
| b. | Warm start (after 36 hours of unit shut down) | **1000** |
| | | |
| c. | Cold start (after 72 hours of unit shut down) | **150** |

The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired and the expected numbers of Steam Generator start-

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| | ups while designing the FGD system. |
| 1.03.00 | **Design Criteria** |
| 1.03.01 | The Flue Gas Desulphurisation (FGD) System shall be designed to meet all the conditions specified above. Representative coal and ash analysis for the expected coal and oil are given in Sub-section-II-A (Project Information), Part-A, Section-VI for each project. The FGD system and all the associated auxiliaries shall be designed to comply with the requirements stipulated under 'Guarantee Point' and 'Design Point' conditions indicated in Sub-Section-V, Part-A, Section-VI of the Technical Specification for the respective projects. The values indicated for FGD sizing shall be considered as minimum design criteria. These shall be modified to more conservative values if Contractor experience warrants the same. However, no credit shall be given to the Contractor for this during evaluation of the bids. Utilization of these values in no way relieves the Contractor of his responsibility to meet all the guarantee requirements. The Contractor shall also furnish along with his offer the detailed calculations and data along with his Bid to establish as to how the Bidder will meet the efficiency requirements both at design and guarantee point as specified in FGD sizing criteria. |
| 1.03.02 | The FGD system shall be installed downstream of the ID fans and shall be based on wet Limestone Forced Oxidation Process. The FGD system shall be designed to achieve the required $SO_2$ capture without the use of oxalic acid or any other additives. The FGD System shall be designed so as to be in operation whenever the Steam Generator is in operation.<br><br>However, provision shall be made by the Contractor for facilitating operation of unit with emergency FGD bypass. This shall also facilitate the online maintenance of absorber system and associated equipment's. The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. For this purpose. Motorized Guillotine type gates has be provided at (i) hot gas inlet to Booster Fans, (ii) Outlet of Booster Fans and (iii) in the bypass duct (common Flue Gas Duct going towards the existing Chimney). Further, Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct by the Contractor. The same shall also be taken into account while designing the control & logics for the FGD System. |
| 1.03.03 | The wet absorber system shall be designed to maintain the required $SO_2$ removal. |
| 1.03.04 | In order to be compatible to all possible modes of operation, the design of the FGD plant shall enable short start-up times, compatible with load changes in the Steam Generator and shall ensure reliable mode of continuous operation. |
| 1.03.05 | The flue gas desulphurization plant (FGD) shall be designed to be operated with limestone as specified in Sub-Section-V, Part-A, Section-VI of the Technical Specification. |

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| 1.03.06 | The FGD and the ancillary facilities shall be suitable for unlimited operation with all transients and at any load point between the minimum and maximum load point of the Steam Generator. Further, the FGD plant shall be suitable for an unlimited operation at any pollutant concentrations between minimum and maximum without exceeding the emission values of $SO_2$ emission of less than 100 mg/$Nm_3$ (6% $O_2$ dry). |
| 1.03.07 | In case of failure of the SG and ancillary equipment, the FGD plant shall be brought automatically to the off-load operation without restriction by the current load case by suitable measures. |
| 1.03.08 | In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, flue gas damper upstream & downstream of FGD, Process water pump & lube oil system of Booster Fan & Ball Mill) which may cause irreversible damage to the FGD System shall be connected to the emergency power supply system to be provided by the Contractor. Bidder shall furnish a list of all such Auxiliaries in their bid proposal. |
| 1.03.09 | In case of shutdown and outage periods, draining and flushing of limestone slurry and gypsum slurry pipe work, tanks and all other items being in contact with limestone slurry or gypsum slurry shall be possible without restriction and without necessity of extensive or unusual preparation and activity. Draining and flushing which are required even during short time outages or an emergency shutdown shall be started automatically and by remote control from the Control Room. |
| 1.03.10 | AII items or equipment which are subject to wear, abrasion or failure (e.g. nozzles, pumps, pipe work, etc.) shall be designed and installed for easy replacement, repair and maintenance. |
| 1.03.11 | The design and the construction shall be performed so as to avoid stress corrosion cracking, galvanic or other types of corrosion. Especially when using two different alloys, appropriate measures shall be taken to avoid corrosion. This is subject to approval by the Employer. |
| 1.03.12 | All items of equipment including flue gas ducts, expansion joints, etc. shall be designed considering thermal and mechanical strength as a function of the maximum temperature which might occur in case of a failure of any upstream equipment. |
| 1.03.13 | Waste water which might be generated during flushing and cleaning procedures of the equipment (e.g. lime slurry bins, pipes, trucks, etc.) shall be collected in sump and shall possibly be reused in the wet absorber. |
| 1.04.00 | **Justification of Proposed Design** |
| 1.04.01 | All the design procedures, systems, and components proposed shall have already been adequately developed and have demonstrated good reliability under similar or more arduous conditions elsewhere. |

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| 1.04.02 | The Bidder shall submit with the offer, comprehensive information on how the L/G ratio, mass balance, spray nozzle cone angle, spray nozzle arrangement, limestone consumption etc. of the proposed design has been arrived at. The Contractor shall also submit alongwith the offer, a detailed write up on the proposed design features with recent design modifications, if any, and their specific advantages over the previous designs. |
| 1.05.00 | **Statutory Approval** |
| | The engineering, design, supply and installation of FGD system and the associated auxiliaries shall comply with the applicable safety code and regulation of the locality where the system is being installed. |
| 1.06.00 | **Location & Layout Requirements** |
| 1.06.01 | The Contractor shall offer the best design to accommodate the Flue Gas Desulphurisation (FGD) System and Lime stone & Gypsum handling & storage system within the confines of the space available. The location of FGD System and associated facilities shall be decided by the Bidder after visiting the Project site. |
| 1.07.00 | **Capital Overhaul of FGD System** |
| | Employer envisages to carryout the capital overhaul of units once in three (3) years. The design and materials for various equipments/auxiliaries etc. shall be selected by the Contractor keeping in view the above requirement of the Employer, such that no major repairs/replacements, requiring shutdown of the unit, are needed in between the capital overhauls. |
| 1.08.00 | **Maintenance** |
| 1.08.01 | The Contractor shall provide adequate handling facilities & approach as for carrying out on-line and off-line maintenance of the FGD system and its auxiliaries. In order to carry out on-line maintenance, it shall be possible to readily disassemble, repair and reassemble the equipment supplied in the shortest period. |
| 1.09.00 | **Noise level** |
| | The equivalent weighted average of sound level measured at a distance of 1.5 m above floor level in each elevation and one meter horizontally from the base of any equipments furnished and installed under these specifications, expressed in decibel to a reference of 0.0002 microbar, shall not exceed 85 dB(A). |
| **2.00.00** | **EQUIPMENTS AND SYSTEMS SPECIFICATIONS** |
| | Specified hereafter are the minimum acceptable functional requirements of the Employer, and all components, equipments and systems for the Flue Gas |

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Desulphurisation System shall be designed to cater to these requirements. Compliance to various stipulations of the Technical Specifications, functional requirements of Employer and utilization of various parameters and their values in the specification by the Contractor shall in no way relieve the Contractor of his responsibilities to meet all guarantee requirements or of providing completely safe and reliable operating equipment/systems.

The complete FGD system and the associated auxiliaries shall be designed by the standard industrial practices. The FGD system shall be designed to achieve the required $SO_2$ capture without the use of oxalic acid or any other additives. Only field proven materials for similar application shall be used for the system. The complete installation of liners shall be made under the supervision of the liner supplier as per their guidelines.In the execution of the welds contractor must ensure that welding material has same corrosion resistance as the actual plate surface.

Alloy to carbon steel welds must either be hidden behind a covering strip of alloy material, or be executed by a special welding procedure ensuring the same quality at the weld surface as the alloy lining. All welding which shall be in the contact with process fluids shall be executed under the supervision of the designer/manufacturer.

**3.00.00 FLUE GAS SYSTEM**

3.01.00 The entire flue gas system, flue gas ducts, absorber etc. shall be designed to meet the following conditions:

| | | |
|---|---|---|
| 1. | Design internal pressure at 67% yield strength (mm wc) | +660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher |
| 2. | Design Inlet Gas Temperature (deg.C) | 150 |
| 3. | Short temp excursion temperature of inlet gas (for approx. fifteen (15) minutes at a time) (deg. C) | 300 |
| 4. | Inlet Dust Burden in Gas (mg/Nm3) | 200 |
| 5. | Maximum flue gas velocity through the Absorber (M/sec) | Not more than 4 m/s at Design Point Conditions |
| 6. | Recirculation Slurry pH | Not less than 5.5 under all operating conditions |

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| **3.02.00** | **Design** |
| 3.02.01 | The flue gas ducts shall be sized and designed to meet all the criteria as specified in Cl. No 16.00.00 this subsection. |
| 3.02.02 | All ducts with operating temperature above $60^0$C shall be insulated in accordance with cl. No. 17.00.00 of this sub section. |
| 3.02.03 | The duct layout shall ensure that there is no accumulation of acid mist on the duct floor. |
| 3.02.04 | The duct to Absorber inlet shall be made of Carbon steel of minimum 7mm thickness. The duct to Absorber inlet shall be made of Carbon steel of minimum 7mm thickness. The duct from Absorber outlet to bypass duct shall be made of Carbon steel of minimum 7mm thickness with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. |
| 3.02.05 | In addition to the base offer as described above, the bidder may also submit an alternate offer for a different material / lining of duct from Absorber outlet to stack, if the bidder has previous experience of the same. The bidder should have supplied a similar design of duct in previous installations for similar application. Bidder shall indicate the applicable price implication for such an alternate offer in the relevant Bid Proposal sheet. The Bidder shall also furnish details of the previous installations of such system and bring out all the technical features of the system proposed. Bidder to note that application of lining material in the ducts shall be carried out under the supervision of designer/manufacturer. Bidder to note that application of lining material in the duct shall be carried out under supervision of Designer/Manufacturer. |
| 3.02.06 | Wherever required, expansion joints of proven design shall be provided in the ducts to take care of differential expansion in the system. The material chosen for expansion joints shall suitable for the duty conditions and the corrosive atmosphere of the FGD system and shall be field proven for similar applications. The expansion joints shall be guaranteed for faultless material and workmanship, for a minimum guaranteed life of not less than 20000 hrs. of operation. During Guarantee period any defects noticed in the expansion-joints due to faulty material and workmanship shall be rectified by the Contractor free of cost. |
| 3.02.07 | The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired, for the complete load range of operation and the expected numbers of Steam Generator start-ups while designing the Chimney flue liner. The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. |

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| | The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide. The design of wet ducts and stacks system shall consider the Stack liquid discharge (SLD), Corrosion/chemical attack, Condensate collection system and its drainage etc. |
| **3.03.00** | **Gates & Dampers** |
| 3.03.01 | The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. Guillotine gate type damper shall be provided by the Contractor before the suction of each Booster fan. A gas tight, motor operated Guillotine gate shall be provided by the Contractor at the outlet of each Booster fan. A gas tight, motor operated Guillotine gate shall be provided by the Contractor in the bypass duct (flue gas duct connecting the existing chimney). |
| 3.03.02 | All gates/dampers shall be designed to withstand the operating flue gas temperature without distortion. |
| 3.03.03 | There shall not be any backlash, play, etc. with linkage mechanism, actuator and final control element. |
| 3.03.04 | Thermal expansion of ducting shall not produce stress in louvers, linkage arrangement etc. |
| 3.03.05 | Outlet dampers of seal air fans shall be pneumatically operated, suitable for remote manual operation**.** |
| 3.03.06 | All pneumatically operated interlocked dampers actuators shall be provided with solenoid valves. |
| 3.03.07 | A quick acting biplane damper shall be provided by the Contractor in the bypass duct (flue gas duct connecting the existing chimney) for quick opening to allow bypass to come into operation in case of emergency. The damper shall be capable of quick opening during emergency conditions within a time of 10-20 secs. Bidder should indicate the required opening time for bypass damper for emergency operating condition. |
| 3.03.08 | All the gates shall be designed for tight shut off. The Guillotine gate type dampers mentioned at Clause No. 3.03.01 above shall have a guaranteed gas tightness efficiency (on flow) of not less than 99.95% along the duct as well as from the duct to atmosphere or from atmosphere to the duct, depending on the pressure in both the damper open and damper closed condition without the use of seal air fans of the damper. The bypass damper shall have a guaranteed gas tightness efficiency (on flow) of not less than 99.5% and 100% leak tight with seal air fans under operation. The gas tightness shall be demonstrated at shop for minimum one type of damper of each type and size. |
| 3.03.09 | The dampers shall be pneumatically operated and controlled from the control room. Provision shall be made for giving signal automatic bypass controls of the absorber in case of failure of the absorber spray system or the GGH. The dampers shall have provision for manual operation, through a hand wheel. The force required for manual operation of the gate shall not exceed 35 kg (max.) at the rim of the hand wheel. |

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3.03.10 The isolating gates shall be provided with locking devices to permit locking in fully closed position.

3.03.11 **Pressurization Fans:**

a) All gates shall be provided with 2x100% pressurization fans to achieve 100% sealing efficiency.

b) The location and scheme for pressurization system shall be subject to Employer's approval.

3.03.12 All gates shall be designed to withstand the operating air and flue gas temperature without distortion.

3.03.13 All guillotine gates shall be located in horizontal duct to avoid fly ash build up when in closed position and shall be of top entry type.

**4.00.00 BOOSTER FAN:**

4.01.00 The Booster Fans shall be located downstream of the ID Fans (Induced Draft Fans) in the inlet duct to Absorber shall be capable of handling the pressure drop in the FGD system & ducting and wet stack of 150 m height also considering the exit loss from wet stack over the entire load range with any one or both Booster fans in operation in conjunction with one or both ID fan in operation while firing the specified range of fuels. Additionally a pressure loss of 100 mm wcl (excluding margin) shall be built up in booster fan design criteria as mentioned below to take care of pressure loss due to future installation of De-Nox system.

Booster Fans shall be sized such that they satisfy the criteria stipulated below.

4.01.01

| S.N. | Description | Booster Fan |
|---|---|---|
| 1 | Type of fans | Constant speed, axial type. |
| 2 | No. of fans per unit | Two |
| 3 | Fan sizing criteria with all the following conditions occurring together : | Booster Fan to be sized for one (1) Booster Fan stream in operation taking into account following factors occurring |

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|---|---|---|
| | | together: |
| | (i) Flue Gas Flow through fan | 920 $m^3$/sec for all 800 MW units<br>724 $m^3$/sec for 660 MW units of Mouda, Tanda , Nabinagar STPP & Barh-I<br>802 $m^3$/sec for 660 MW units of Meja<br>893 $m^3$/sec for 660 MW units of Solapur<br>297 $m^3$/sec for 250 MW units of Nabinagar TPP |
| | (ii) Power supply frequency | 47.5 Hz |
| | (iii) Pressure at Booster Fan suction | 0 mmWc |
| | (iv) Gas temperature (degree Celsius) | 150 |
| 4.02.00 | The fans shall also fulfill following sizing criteria in addition to those mentioned at clause 4.02.01 above | Each fan to be sized with following conditions occurring together. |
| | (i) No. of fans in operation | 2 |
| | (ii) Flue gas flow through each fan | 727 $m^3$/sec for all 800 MW units<br>600 $m^3$/sec for 660 MW units of Mouda, Tanda , Nabinagar & Barh-I<br>645 $m^3$/sec for 660 MW units |



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| | | | of Meja<br><br>678 $m^3$/sec for 660 MW units of Solapur<br><br>237 $m^3$/sec for 250 MW units of Nabinagar TPP |
| | (iii) | Margin over flow | 20% |
| | (iv) | Margin over pressure requirement | 44% over the calculated value |
| | (v) | Power supply frequency | 50 Hz |
| | (vi) | Pressure at Booster Fan suction | 0 mmWc |
| | (viii) | Gas temperature (degree Celsius) | 150 |
| | (viii) | Flue gas control | Blade pitch control |
| | **Note to 4.02.01 & 4.02.02**: Booster fan shall have a minimum stall margin of 10% over the Design duty points. | | |
| 4.02.01 | Both fans shall operate with highest possible efficiency which shall be nearly equal at the Guarantee point flow and test block points. | | |
| 4.03.00 | Fan components along with servo/blade pitch control mechanism shall be designed to withstand and continuously operate with the maximum air or flue gas temperature that these fans will be required to handle. Fan component shall also be designed to withstand the excursions in flue gas temperature up to 300 degree Celsius, which may persist for about 30 minute duration. Such temperature excursion will not inhibit the safe and smooth operation of fans or cause any damage or increased maintenance. | | |
| 4.04.00 | The construction of Booster fans shall also comply with following requirements | | |

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| | **DESCRIPTION** | **Booster Fans** |
| | Type of fan blades | stream lined, aerofoil shaped section |
| | Blade material | Nodular Cast Iron or High Wear Resistant Steel with or without Hard coating as per the proven practice of the fan manufacturer |
| | Fan rotational speed | 600 rpm (max.) |
| | Air/Flue gas flow | blade pitch control |
| | Fan critical speed | not less than 125% of fan maximum operating speed |
| | Fan component design* | to withstand torsional stresses three (3) times the normal full load motor torque at all speeds |
| | Fan casing material thickness | Abrasion and wear resistant, high BHN steel having minimum 8.0mm thickness or 12mm mild steel with liner of thickness 10mm (min.) |
| | Fan Housing design | for shut off head of fan |

*Note :

(a) Contractor shall submit detailed calculations, for Employer's approval, to confirm compliance with above requirements for all fan components, specifically for fan shafts, impeller hubs and impeller as a whole. Areas of high stress concentration and residual stresses, like welded attachments shall be avoided on the fan rotor/shafts. Combined static, dynamic as well as residual stresses shall be demonstrated to be within allowable limits. These fan components shall last the life of the plant with such combined stresses present in them.

(b) Although employer envisages to install highly efficient electrostatic precipitator to control particulate emission, however. Bidder shall select the Booster fan components such as blades, hubs, casing etc. to encounter the high dust burden of the order of 250 mg/$Nm^3$. The minimum wear life of Booster fan components shall not be less than 25000 hours of operation from the date of commissioning.

4.05.00 **Fan Bearings**

(a) Bearing shall be provided with oil bath to prevent damage in case of complete loss of plant auxiliary power when the fans must coast down

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without power.

(b) Size oil reservoir in bearings housing for maintaining lubrication for extended periods in case of oil circulation system is out of service.

(c) Cooling air circulation to be provided across main bearing

(d) Adequte numbers of duplex Pt-RTD (100 ohm at 0 degree Celsius) and temperature indicator shall be provided for each bearing. Local as well as remote monitoring features shall be provided.

(e) For mounting of vibration pads/pickups, flat surfaces shall be provided both in X and Y directions, by the Contractor on the bearing housing.

4.06.00 **Fan balancing**

(a) The fans shall be statically and dynamically balanced before shipment.

(b) Balancing of each fan shall be checked and adjusted at site, if necessary.

(c) Natural frequency of all fan components shall be established by vibration testing to ensure that no part of the wheel is adversely excited by any force generated at operating speeds.

(d) The fan blade shall be subjected to natural frequency test. The other components of fan wheels need not be subjected to natural frequency test if supplier can prove that these component are very rigid and have very high natural frequency compared to the operating frequency of respective fans giving justification.

4.07.00 Booster fans shall meet following operational requirements.

| | Description | Booster Fans |
|---|---|---|
| (a) | Mode of operation | i) two fans in parallel.<br>ii) one fan (one stream in operation) |
| (b) | Fan control system | i) capable of operating in automatic mode for all regimes of operation in a steady and stable manner<br>ii) The final control element shall not have any backlash, plays etc., and shall operate in the range of 20% to 80% depending upon generating loads upto Boiler MCR |

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| | (c) | Vibration | For mounting of vibration pads/pickups (in the Employer's scope) flat surfaces shall be provided, both in X & Y directions, by the Contractor on the bearing housing in such a way,so that welding/screwing of the pads shall be possible. |
| | (d) | Bearingmetal temperature monitoring | Shall be possible from remote as well as locally, using atleast 2 nos. of duplex platinum RTD's (100 ohms at0 deg. C) per bearing |

4.08.00 The fans shall be suitable for parallel operation and sharing the load capacity over the entire range of operation without hunting. Pulsation shall be avoided by suitable design of fans and

4.09.00 **Fan Casing :**

(a) The fan casing shall be split to provide easy removal of the fan hub/impeller for replacement and repairs.

(b) The sections shall have gasket joints to ensure airtight sealing.

(c) Access doors shall be provided in each suction chamber casing and diffuser.

4.10.00 **Drain Connection:**

Drain connections shall be provided at bottom most point of the fan housing to the nearest trench.

**5.00.00 ABSORBER**

The unit shall be provided with an independent/dedicated absorber.

5.01.00 The contractor may offer either a spray type absorber, with single or multiple levels of spray, or an absorber with gas bubbling through the slurry, as per Bidders/Colaborator's proven practice. Only proven system in successful operation in previous installations supplied by the contractor shall be offered.

**A Spray System (if offered)**

(i) The contractor shall provide spray system and minimum spray levels required to meet the stipulated guarantee and design requirement. The spray system (including slurry recirculation pump & nozzles) shall be sized to achieve a desired L/G ratio required to meet the guarantees $SO_2$ removal efficiency, with redundancies specified

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under this clause.

(ii) In case the contractor offers an absorber with multiple levels of spray nozzles, each spray level shall be provided with independent 2x100% pumps. Alternatively, the contractor may offer a spare spray level with each spray level served by an independent 100% capacity pump. In case the contractor offers a single level of spray, one number of standby pump of the same capacity & head as the working slurry recirculation pumps shall be provided. The contractor shall provide spray system / spray levels only as per his proven practice, which should be in successful operation elsewhere.

(iii) The slurry recirculation pumps shall have a minimum margin of 10% on flow and 10% on frictional head, over the actual requirement for meeting the guarantee and design point conditions. All slurry recirculation pumps including motors shall be of the same size and type.

(iv) The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side.

(v) The slurry recirculation pumps shall be wear-resistant and equipped with flushing devices to prevent sedimentation and shall be designed and installed in a manner to allow easy replacements, repair and maintenance. The slurry recirculation pumps shall be equipped with oil level indication, coupling guard and collecting equipment for leakage, made of resistant material. Single mechanical seals with automatic flushing with a connection for additional manual flushing shall be provided.

(iv) The slurry pumps shall also comply with the requirements stipulated in Clause 8.00.00 of this sub-section.

(v) Sufficient redundancy, as per the proven practice of the contractor, shall be provided in the spray nozzles. Minimum 10% spare nozzles shall be provided at each level.

**B Bubbling Type Absorber**

(i) In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No re-circulating pump and spray header and nozzles shall be required in such case. However, 2x 100% Cooling Pumps instead of Slurry Recirculation shall be provided. The spray headers & piping for cooling pump discharge shall be made of Alloy 59 or C276 and nozzles shall be made of Silicon Carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. The Cooling Pumps shall be installed inside a building.

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The sparger and gas riser tubes shall be made proven material which shall have a minimum life of 5 years.

Minimum 10% redundancy, shall be provided in the Sparger Tubes.

**5.02.00 Absorber Recirculation Tank**

Sufficient number of agitators, as per the proven practice of the contractor, shall be provided for thorough mixing of the re-circulating slurry. In case the Contractor's Absorber includes side entry agitators, the contractor shall offer and demonstrate mixing arrangement such that n-1 number of agitators are sufficient to avoid the slurry settlement in the absorber tank in case of one agitator under breakdown (n-total no. of working agitators). In case vertical agitators in Absorber are offered, one complete mechanical assembly of agitator shall be supplied as warehouse spare for each Absorber.

**5.03.00 Absorber Oxidation Systems**

5.03.01 The contractor may offer either a grid type oxidation system or a sparge jet oxidation system or lance type or air rotary sparge system or jet air sparger system for oxidation of sulfite sludge to sulfates, or any other proven system as per the practice of the FGD vendor.

5.03.02 The oxygen required for oxidation shall be supplied by 2x100% oxidation air blowers for each absorber. The compressor/blower shall be sized to supply at least 2.5 times the stoichiometric air requirement for spray tower process & at least 4.0 times the stoichiometric air requirement for Bubbling Type process or the actual requirement, whichever is higher, under the following condition, all occurring simultaneously. The natural oxidation of sulfite by residual oxygen in flue gas shall not be considered for this purpose.

| **Load** | **Design point Flow** |
|---|---|
| Flow | Minimum 2.5 times for spray tower process & 4.0 for Bubbling Type process the stoichiometric requirement |
| Head | For spray tower process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 8500 mmwc whichever is higher.<br><br>For Bubbling Type process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 3500 mmwc |

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| | | whichever is higher. |
| | Margin on Head | 10% under above conditions. |
| | Ambient Conditions | 45°C / 60% RH. |

5.03.03 Oxidation nozzles / spargers shall have a minimum redundancy of 10% or as per the contractor's proven practice whichever is maximum.

5.03.04 The oxidation system shall be complete with a quenching system to cool down heated oxidation air in order to prevent any scaling or buildup that could occur at the sparger tips due to localized evaporation of recycled slurry.

**5.04.00 Gypsum Bleed Pump**

Each absorber shall be provided with 2x100% Gypsum Bleed Pumps for supply of gypsum slurry to Gypsum Dewatering system. Each Gypsum bleed pump shall be sized to bleed-off the gypsum slurry from the absorber with slurry solid concentration not exceeding 30%, under the following conditions, all occurring simultaneously:

| | |
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| Load | Design point |
| Flow | 100% of gypsum produced at Design point condition |
| Head | As per system requirement |
| Margins | Flow -- 15%<br>Head – 20% |

The pumps shall be designed to meet the stipulations of Clause No.9.00.00 of this Sub-Section.

Provision shall also be provide in the Gypsum Bleed Pumping system by provision of tap off, valves etc. for pumping the gypsum bleed to alternate source.

**5.05.00 Emergency Spray System**

An emergency cooling system for automatic spray of quenching water for a sufficient time (minimum 15 min) at the inlet to the absorber, in case the gas temperature exceeds the design temperature due to failure of upstream equipment's shall be provided to protect the FGD and all other sensitive downstream equipment against high flue gas temperatures. The water shall be supplied from an elevated tank (emergency water tank) installed near to the absorber. The tank volume and the

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| | injection lances/nozzles shall be designed to protect the inlet duct and the lining of the absorber. The inlet duct shall be sloped towards the absorber. |
| **5.06.00** | **Design** |
| 5.06.01 | The design and arrangement of the absorber shall be field proven for successful long-term operation in conjunction with a coal fired power plant. |
| 5.06.02 | The design of flue gas ducts and inlet and outlet hoods of the FGD as well as guide vanes and baffle plates shall ensure a homogeneous flue gas flow with respect to the distributions of:<br>(i) temperature<br>(ii) velocity<br>(iii) dust content<br>(iv) slurry injection and distribution.<br><br>The above shall be proven by two phase Computational Fluid Dynamics simulations (liquid and gas). The scope of modelling shall include flue gas path inside the absorber vessel including inlet and outlet duct. Homogeneity shall be ensured, if the deviation from average is less than $\pm$10%. Further, in the Absorber outlet hood no internals such as guide vanes and baffle plates shall be allowed. |
| 5.06.03 | The fabrication of the absorber vessel shall follow common practice as there shall be no longitudinal seams located behind any attachment or obstruction which would prevent inspection of the welds. Nozzles, access ways, and their reinforcements shall not be located in or on any seam. Inaccessible gaps or hollow beams shall be avoided. |
| 5.06.04 | The absorber shell shall be designed for pressure loads, piping forces and moments, wind and seismic loads and all other loads imposed on the absorber. Bracing and reinforcement shall be adequate to prevent deflection and vibration. Internal supports for mist eliminator sections, etc. shall be designed to withstand the flooded weight of the supported section. The absorber and its structural supports shall be designed for the maximum operating loads including design positive & negative internal pressure, static head, external attachment loads (such as exerted by piping) wind load using the allowable stresses permitted by the applied standards. |
| 5.06.05 | It shall be possible to reach the $SO_2$ emission guarantees, at Guarantee point condition, with at least one spray level continuously out of service (in case the absorber is equipped with several spray levels) or one spare pump continuously out of service. |
| 5.06.06 | Three stage chevron type Mist Eliminators (ME) made of polysulfone or stainless steel shall be provided at the exit of the absorber. Provision shall be made for continuous washing of both ends of the first & second stage and the front section of the third stage of mist eliminators. Wash water arrangement shall also be provided at the back end of the second stage of mist eliminator. If the mist eliminator washing system is designed for cyclic washing of different sections, all the valves required for cycling shall be motorized or pneumatically operated. The automatic valve for the spray system shall be easily accessible on a platforms close to the mist eliminator. |

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| | Entrained slurry shall be collected by mist eliminators downstream of the slurry spray system to avoid carry-over of slurry to the stack.<br><br>The ME system shall be equipped with washing and drain provisions, where drains are directed into the absorber. Washing provisions shall include external and internal piping systems with replaceable nozzles, water pressure booster pumps (if required) complete with all piping, valves, instrumentation and controls. The mist eliminator wash piping/header shall be constructed of rubber lined carbon steel or glass fiber reinforced plastics. Polypropylene or PVC is also acceptable for mist eliminator wash headers provided Contractor or its Collaborator has proven experience for the same. Ease of replace ability and placement of the mist eliminator on maintenance platforms is an important requirement. The ME shall be designed to allow for efficient cleaning in process. Test ports shall be provided downstream of the mist eliminator to enable performance testing.<br><br>The mist eliminator system shall be capable of withstanding high velocity spray water jets typically employed during manual cleanings. The ME shall be constructed in individual cells. The design shall safely avoid ME vibration and/or humming. The individual cells shall be sized so that no more than two maintenance personnel are needed to handle them manually when they are fully scaled or plugged, and the cells shall be capable of passing through the access doors for the mist elimination section. Easy access for placement and replacement of the mist eliminator shall be incorporated in the design of the mist eliminator arrangement and the absorber vessel.<br><br>Walkways shall be arranged and also measures shall be taken as appropriate to permit the internal components to be disassembled and reassembled during repairs without the necessity for time-consuming preparatory work. The headroom shall have a height of more than 2200 mm. The mist eliminator support beams shall be designed to act as maintenance walkways approximately 300 mm wide and shall allow for a minimum 500 Kg/m2 load. The support beam/walkways shall provide personnel access to all mist eliminator modules, wash headers and wash nozzles.<br><br>Adequate number of viewing ports with flushing devices connected to automatically operating washing system shall be delivered at following locations:<br><br>(i) upstream of 1st stage<br>(ii) between 1st and 2nd stage<br>(iii) downstream of 2nd stage.<br>(iv) downstream of 3rd stage<br><br>The regular flushing shall be done in a defined time sequence. |
| 5.06.07 | The absorber oxidation tank shall be provided with an over flow line (for spray tower process) complete with sealing pot, over flow and drain line. The absorber over flow shall be taken to a sump in the absorber region, from where the slurry shall be pumped back to the absorber by a sump pump. |
| 5.06.08 | Materials used shall be suitable for the chemistry of the absorber process and resist abrasion from any particulate contained in the incoming flue gas and from the |

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| | particulate of desulphurization process. |
| 5.06.09 | All equipment located in the gas path or connected to such equipment shall be designed to withstand the maximum inlet gas temperature fluctuations. There shall be no damage whatsoever to any equipment as a result of these fluctuations. |
| 5.06.10 | The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as well as intermittently. |
| 5.06.11 | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br><br>The absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. |
| 5.06.12 | The material of process equipments of flue gas desulphurization system shall be appropriate for the chloride content and pH level at which the process is to operate. |
| 5.06.13 | All internal members shall be lined with minimum 2 mm Alloy 59/ C276 . All metallic fasteners which are provided inside the absorber/absorber wet-dry interface ducting shall be of Alloy 59/ C276. |
| 5.06.14 | The absorber wet-dry interface shall be made of solid Alloy 59 or C276 of minimum 6 mm thickness. |
| 5.06.15 | The other bridges (supports) shall be lined with minimum 2 mm Alloy 59/ C276. |
| 5.06.16 | Lining material and technical application requirements shall be furnished by manufacturer experienced with similar FGD plants. Proof of such experience shall be provided by the Contractor. |
| 5.06.17 | The spray headers (if provided) and air supply headers shall be made of FRP or Carbon Steel with rubber lining (minimum 10 mm natural rubber lining), corrosions and erosion resistant in the inner and outer side (Silicon Carbide coating on metal/FRP surface exposed to slurry). Optionally ceramic coating is also acceptable provided bidder/Collaborator has proven experience for the same. The slurry spraying system shall be made of material resistant to erosion and corrosion. During the lifetime of the plant, only the nozzles shall be replaced. The distribution system of the slurry shall be hydraulically optimized. The spray nozzles shall be of silicon carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. The design of the spray nozzles shall be such that rapid wear, encrustation and plugging are avoided. Nozzle pipes and slurry spray nozzles shall be with bolted flanged connections. Nozzle pipes shall be installed easily to be removed partially through absorber modules. |
| 5.06.18 | In case the absorber is equipped with several spray levels they shall be designed as follows: |

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| | (i) The last spray level upstream the mist eliminator shall be operated only in counter-flow.<br>(ii) Depositions at downstream spray level and mist eliminator by co-flow injection of slurry shall be avoided.<br>(iii) The spray lances shall be equipped with bars for installation of scaffolding without any offset. The spray levels shall be designed for a load of min. 500 kgf/$m^2$.<br>(iv) A flushing device of the spray levels with water shall be installed. Flushing shall take place if spray levels are out of operation. |
| 5.06.18 | The absorber shall be self-supported from the bottom to suit site conditions. Absorbers which are externally supported from the structure are also acceptable provided Bidder or its Technology Collaborator has proven experience of supplying such Absorbers which are operating for more than 5 years. The absorber shall have adequate stiffening arrangement on the external side. Internal stiffeners shall be used only where it is not possible to provide proper external stiffening with approval of employer. |
| 5.06.19 | It should be possible to build platforms inside the absorber for access to all parts of the absorber during maintenance. In case the contractor offers a multiple spray level design, minimum distance of 1.5 m shall be maintained between individual spray levels. Arrangement shall be properly designed to facilitate access for maintenance and replacement of spray nozzles. |
| 5.06.20 | The spray piping, mist eliminators and its supporting structure shall be designed to carry sufficient load during maintenance. |
| 5.06.21 | The bottom of the absorber sump shall be designed so that there will be **an** easy entrance for a man with a wheelbarrow. Therefore the arrangement and dimensions of the inspection door of the absorber at ground level shall be designed to allow for this. The bottom of the absorber sump shall be designed in such a way that complete drainage of the absorption liquid/slurry is possible and is accessible without damage of lining/rubber. |
| 5.06.22 | In case of Spray Tower System, Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps. In case Bubbling type, suction strainers shall be installed at the suction side of Gas Cooling Pumps. For the agitators a flushing system for start ups shall be provided. |
| 5.06.23 | It should be possible to discharge the absorber sump into the emergency drain tank within 2 hours. |
| 5.06.24 | At the head of the absorber two manholes shall be provided to reduce the draught of the stack during outage. |
| 5.06.24 | Equipment's required for internal & external inspection shall be furnished by the contractor in brand new condition. List of all such items shall be furnished along with the Bid. The formation of agglomeration, deposition & caking shall be avoided. For |

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| | areas, where this might occur, (e.g. mist eliminators, spray levels) the Contractor shall submit a cleaning procedure including the required safety measures as part of the inspection concept. |
| **6.00.00** | **LIMESTONE GRINDING AND SLURRY PREPARATION SYSTEM** |
| **6.01.00** | **Type** |
| | A common limestone and slurry preparation system is envisaged for each project. Contractor shall supply wet limestone grinding and slurry preparation system complete with all auxiliaries and slurry storage tank of proven design. |
| **6.02.00** | **Limestone Silo:** |
| 6.02.01 | The Contractor shall provide 2X100% Limestone storage silos each silo having minimum 24 hours storage capacity equivalent to the requirements of FGD system of all the units operating at Design point. The storage silo shall be complete with supporting steel structure, platforms, staircase, air canons power operated gates, gravimetric feeders, level switches, air relief devices, etc.. |
| 6.02.02 | The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 (Part 1 to 3). The storage silo shall be capable of feeding the limestone by means of gravimetric feeder to the wet ball mills. The top of the unloading hopper shall be equipped with a grate to protect the downstream equipment from gravel lumps or tramp waste. |
| 6.02.03 | Each Silo shall be provided with sufficient no. of level transmitters. |
| 6.02.04 | Each silo shall be provided with minimum 3nos. of air canons at necessary location, capable of removing the jamming/clogging/blockage in the silos. |
| 6.02.05 | For dust free operation each silo should be provided with a covering arrangement and a self cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc. |
| 6.02.06 | For each silo facilities shall be provided for unloading the bunker, through feeder, to a truck at ground level, along with all necessary chutes and diversion chutes. |
| 6.02.07 | Lime stone silo with hopper may be fabricated at factory in segments, transported and welded at site. |
| **6.03.00** | **Bunker Shut-off Gates** |
| 6.03.01 | A bunker outlet chute shall be provided for feeding limestone from bunker to the feeder. The size of the opening chute shall be sufficient to ensure proper flow of the limestone. There shall be no reduction of section in the bunker outlet chute from |

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| | bunker to feeder. The inlet chute shall be provided with suitable poke doors/holes in order to remove jamming/blockage. A motorized bunker shut-off gate shall be provided at the inlet to each feeder. |
| 6.03.02 | All parts of the gate in contact with limestone shall be of stainless steel construction. |
| 6.03.03 | The shut-off gates and its actuator shall ensure 100% closing of the gate even with 'bunker full of limestone'. |
| 6.03.04 | Facility shall be provided to open/close the bunker outlet gate, through actuator, from remote as well as local. |
| 6.03.05 | In addition, a hand wheel with proper access shall also be provided for manual operation of the gate. The force at the rim of the hand wheel shall not exceed 35 kg with bunker full of coal. |
| 6.03.06 | For each bunker facilities shall be provided for unloading the bunker, through feeder, to a truck at ground level, along with all necessary chutes and diversion chutes. |
| **6.04.00** | **Gravimetric Feeders** |
| 6.04.01 | Gravimetric feeders shall be sized to meet 110% of the maximum mill capacity. |
| 6.04.02 | The limestone feeder belt shall be of seamless rubber construction. It should be possible to adjust the belt tension from outside without opening the feeder body. |
| 6.04.03 | All parts in contact with limestone except belt shall be of stainless steel construction. |
| 6.04.04 | The feeder shall have adequate instrumentation to detect `loss of flow'. |
| 6.04.05 | The feeder shall have a motor/pneumatic operated gate at the outlet. |
| **6.05.00** | **Wet Ball Mill** |
| 6.05.01 | There shall be 2X100% tube mills for grinding of limestone. Each mill shall be sized to meet 110% of the maximum limestone requirement of all the units in a project operating under the following conditions, all occurring together. |
| | (i) Load — Design point flow |
| | (ii) Flow — 110% of limestone requirement of two absorbers at Design point |
| | (iii) Input Limestone Size — 1" (max.) |
| | (iv) Output Fineness — Output Fineness 90% or higher (as per the requirement of absorber) through 325 mesh (for spray tower process) OR 90% or higher (as per |

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| | the requirement of the absorber) through 200 mesh (for bubbling process)<br>(v) Mill Wear Part Conditions — Near Guaranteed Wear Part Life.<br>(vi) Limestone bond index(kWh/sh.T) — 13 (min) |
| 6.05.02 | All integral auxiliaries of the mills like hydro-cyclones, separator tank & mill circuit pumps shall be sized to meet the above conditions. A 100% stand-by pump shall be provided for the mill circuit pump. |
| 6.05.03 | The mill hydro-cyclone set shall have sufficient redundancy. A minimum 10% spare hydro-cyclone shall be provided in each set of hydro-cyclone. Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. The hydro-cyclone shall be of proven design and shall be provided with replaceable rubber lining. The hydro-cyclone shall be provided with replaceable rubber lining of thickness 12 mm for the feed chamber and 12 mm for the overflow launder.. The liners shall have a minimum wear life of not less than 7000 hrs. |
| 6.05.04 | All parts of the mill including mill body, trunnion, hydro-cyclones, integral pipes, mill circuit pumps and other parts in contact with limestone slurry shall be provided with replaceable rubber wear liners. The wear liners or wear parts shall have a minimum guaranteed wear life of not less than 8000 hrs without reversal of the liners. The guaranteed capacity and fineness of the mill shall not be affected within the guaranteed life of the mil wear parts. |
| 6.05.05 | The material of the balls shall be chosen to ensure that the balls do not lose their original shape and to ensure minimum ball consumption. The contractor shall also guarantee ball consumption per ton of limestone throughput. The contractor shall furnish the minimum ball diameter below which the balls shall be replaced. |
| 6.05.06 | Facility shall be provided for on-load loading of steel balls to the mill. |
| 6.05.07 | The ball mill shall be driven by a motor through a peripheral gear/ central drive system. An auxiliary motor shall also be provided for inching of mills after trip and during maintenance. |
| 6.05.08 | The lube oil system shall have 100% stand-by arrangement for lube oil pumps and oil coolers of each circuit with independent pump / cooler. Wherever required duplex oil filters shall be provided. |
| 6.05.09 | The mill auxiliaries like separator tanks, mill circuit pump, hydro-cyclones and all connecting pipes handling limestone slurry shall have replaceable rubber linings. |

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**6.06.00 Limestone Slurry Preparation / Storage Tank**

6.06.01 The contractor shall provide two (2 nos.) slurry storage tank, common for all mills. Each tank shall be sized to meet 12 hours continuous limestone requirement of all the units operating at Design point. For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower.

6.06.02 The storage tanks shall be equipped with sufficient number of agitators, to avoid settling of limestone, as per the proven practice of the supplier. The agitators shall be designed to meet the requirements stipulated in Cl. No. 11.00.00 of this Sub-Section.

6.06.03 The limestone mill circulation tanks shall be installed indoor beneath the hydro cyclone stations. The slurry storage tank shall be located outdoor.

6.06.04 The slurry preparation tank shall be CS construction with replaceable chlorobutyl/bromobutyl rubber lining of minimum 5 mm thickness.

**6.07.00 Limestone Slurry Supply Pumps & Piping**

6.07.01 2x100% centrifugal type limestone slurry pump shall be provided for each unit. Each limestone slurry pump shall be sized to supply the limestone requirement of one (1 no.) unit, under the following conditions all occurring together.

| | | |
|---|---|---|
| (i) | Load | Design point |
| (ii) | Flow | 110% of one absorber requirement with the limestone requirement at Design point. |
| (iii) | Head | As per system requirement. |
| (iv) | Margins | Flow 10% (minimum)<br>Heads 15% (minimum) |
| (v) | Solids Concentration | Max. 30% by weight or actual as per suppliers practice, whichever is minimum. |

6.07.02 The limestone slurry pumps shall be designed to meet the requirements stipulated in Cl. No.8.00.00. of this Sub-Section.

6.07.03 The limestone slurry pipes shall be sized to minimize erosion and avoid settling of the limestone at part load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 10 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends.

6.07.04 Automatic flushing equipment for all lime slurry pumps and pipes shall be supplied.

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| **7.00.00** | **GYPSUM DEWATERING SYSTEM** |
| 7.01.00 | A common gypsum dewatering system for all the units operating at Design point is envisaged. Contractor shall supply a two stage gypsum dewatering system, consisting of a primary stage of sets of hydro-cyclones and secondary stage of vacuum belt filters for dewatering of gypsum from absorber up to less than 10% moisture. All the equipments supplied shall be proven design with previous installations for similar capacities. |
| 7.02.00 | The Contractor shall provide 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the units operating at Design point. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification. |
| **7.03.00** | **Primary Dewatering Hydro-cyclones** |
| 7.03.01 | Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by the unit operating at Design point with an additional 10% margin. The outlet water content in the gypsum shall be as per the requirement of the vacuum belt filters. |
| 7.03.02 | Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service. |
| 7.03.03 | The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water tank via secondary hydro-cyclone feed tank and secondary waste water hydrocyclone as shown in the relevant tender drawing. |
| 7.03.04 | Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. |
| 7.03.05 | The hydro-cyclone shall be of proven design. The primary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. The feed chamber shall be provided with a minimum rubber lining thickness of 12mm. The liners shall have a minimum wear life of not less than 7000 hrs. |
| **7.04.00** | **Vacuum Belt Filters** |
| 7.04.01 | Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum: |

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| | a. Capcity: 110% of gypsum produced by Absorbers of all the units operating at Design point.<br>b. Outlet Moisture: 10% max.<br>c. Gypsum Purity: 90% (minimum)<br>d. Chloride content: < 100 ppm |
| 7.04.02 | The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs. |
| 7.04.03 | The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design. |
| 7.04.04 | In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs. |
| 7.04.05 | The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design. |
| 7.04.06 | The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism. |
| 7.04.07 | The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. For cake washing only clarified water shall be used. For this purpose, one (1) clarified water storage tank (minimum 1 hr storage) shall be provided along with 2x100 cake washing pumps for each Vacuum Belt Filter . One stage of cloth washing arrangement shall also be provided along with 2x100 cloth washing pumps for each Vacuum Belt Filter. |
| 7.04.08 | The filtrate from gypsum slurry and from cake washing shall be taken to a common or separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump. |
| 7.04.03 | Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Employer. |
| 7.04.04 | A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance. Handling facilities for replacement of heavy components |

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| | of the belt shall also be provided. |
| **7.05.00** | **Vacuum System** |
| 7.05.01 | The filtrate from each belt filter, cake washing & cloth washing shall be taken to a common or separate receiver tank(s) as per the supplier's proven practice. |
| 7.05.02 | Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional margin of 10% (min.) over the above capacity shall be provided for each vacuum pump. |
| 7.05.03 | The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitations under all operating conditions. The seals shall be of proven design. |
| 7.05.04 | Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification. |
| 7.05.05 | The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application. |
| 7.05.06 | Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm. |
| **7.06.00** | **Filtrate System** |
| 7.06.01 | Water from vacuum receiver tank(s) and the secondary waste water hydrocyclone underflow shall be taken to a common filtrate tank for recirculation to the absorber tanks. |
| 7.06.02 | 2x100% horizontal centrifugal pumps shall be provided for recirculation of filtrate water to absorber. 2x100% horizontal centrifugal pumps shall be provided for wash water requirements of belt filter. Alternatively, wash water pump may take suction from the vacuums receiver tanks. Each pump shall be provided with 100% standby in such a case. |
| 7.06.03 | The pump shall be capable of pumping of filtrate water with solid concentration of not less than 10% & particle lumps of 6-7mm. A 10% margin shall be provided in each of the pump. |
| **7.07.00** | **Waste Water System** |
| 7.07.01 | The overflow of the primary hydro-cyclones shall be taken to a secondary hydrocyclone feed tank for feeding the secondary waste water hydro-cyclones. |
| 7.07.02 | The secondary hydrocyclone feed tank shall be sized to provide a minimum storage |

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| | of 1 hr of primary hydro-cyclone overflow with all the units operating at Design Point and no outflow from the tank. |
| 7.07.03 | 2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydro-cyclones. |
| 7.07.04 | Each set of hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. |
| 7.07.05 | The secondary waste water underflow shall be taken to the adequately sized filtrate tank, while the overflow shall be taken to a waste water Tank. |
| 7.07.06 | 1x100% Waste water tank shall be provided (in projects where separate Zero Liquid Discharge system for waste water treatment is not in the scope of the contractor) which shall be sized for 8 hrs storage of waste water with all the units operating at Design point and no out flow from the tank. The Waste water Tank shall be complete with Agitator, level transmitters etc. The waste water collection tank shall be of Steel construction with rubber lining. 2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from waste water tank at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the Technical Specification. The material of Casing and impeller shall be rubber lined Cast Iron (IS:210 Gr FG260). Shaft and Shaft Sleeves shall be Stainless Steel-410. |
| 7.07.07 | All piping, valves & instrumentation upto the employer's terminal point shall be in the contractor's scope. **Contractor shall provide the complete lime dosing system** (in projects where separate Zero Liquid Discharge system for waste water treatment is not in the scope of the contractor) to correct the pH of the waste water by lime (**83% purity**) dosing shall be provided and after mixing of the effluent (using re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. A pH monitor shall be provided at the discharge of the pumps for measurement and control. Complete lime storage, feeding & dosing system shall be in contractor scope. The complete waste water neutralization system shall be automated and controlled from the control room. |
| 7.07.07 | Contractor shall provide 2x 100% Lime Neutralization tanks (in projects where separate Zero Liquid Discharge system for waste water treatment is not in the scope of the contractor) which shall be of minimum 8 hr capacity made of carbon steel with rubber lining along with 2x100% Lime storage silos. The tanks shall be provided with SS dissolving basket, Agitator of SS construction, drain, over flow and dosing connection, level transmitters, Agitators etc. The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 or any |

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| | other proven international standards. The storage silo shall be capable of feeding the lime by motorized rotary feeding system to the Lime Neutralization tank. |
| 7.07.09 | Contractor shall provide 2x 100% Lime Storage Silos (in projects where separate Zero Liquid Discharge system for waste water treatment is not in the scope of the contractor) for feeding lime to the Lime Neutralization tanks. The lime storage silo shall be of minimum 24 hr capacity equivalent to the requirements of FGD system of 2X800 MW at Design point and shall be complete with supporting steel structure, platforms, power operated outlet gates, level switches, air relief devices, etc.. For dust free operation each silo should be provided with a covering arrangement and a self cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc. |
| 7.07.10 | Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level. The Bucket conveyors shall be sized to completely feed each lime silo within 2hrs. Adequate storage and feeding system required for feeding the lime to the Bucket conveyors is also in the Contractor's scope. |
| 7.07.10 | A storage room for storing minimum one (1) month requirement of lime for all the units shall also be provided by the contractor. |
| **7.08.00** | **Auxiliary Absorbent Tank** |
| 7.08.01 | The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump It should be possible to discharge the each absorber into the emergency drain tank within 2 hours. |
| 7.08.02 | The contractor shall provide 2 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours. |
| 7.08.03 | Agitation shall be provided to prevent settlement of slurry by side entry agitators with emergency flush start system. Sufficient number of agitators shall be provided in the tank by the contractor to prevent the solids from settling down. |
| 7.08.04 | The Auxiliary Absorbent tank shall be made of minimum 7 mm thick carbon steel with minimum 4 mm thick rubber lining of best quality bromine butyl rubber and shall also be equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber. |
| 7.08.05 | The Auxiliary Absorbent tank shall be equipped with an opening to enable easy entry of a man with wheelbarrow. |
| 7.08.06 | Coarse-screen(s) of suitable material at suction-side of the pumps shall be provided. |
| **8.00.00** | **SLURRY PUMPS** |

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| 8.01.00 | This Clause covers the design, manufacture and erection of all slurry pumps for the FGD system including the Absorber slurry recirculation pumps, Gypsum bleed pumps, Limestone slurry feed pumps, Mill circuit pumps and any other pump handling slurries. |
| 8.02.00 | The Contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards. |
| 8.03.00 | The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type capable of delivering the rated flow at rated head with margins as specified in the respective clauses. The slurry concentration in the pump shall not exceed 30% by weight except for Mill circuit slurry pumps for which the slurry concentration in the pump shall not exceed 55% by weight. |
| 8.04.00 | All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken form the process water supply |
| 8.05.00 | The pump casing should be radially split to allow easy removal of impeller. |
| 8.06.00 | All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer an hi chrome alloy line pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations. |
| 8.07.00 | For absorber recirculation service a Silicon carbide impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation for similar service. |
| 8.08.00 | The material and thickness of the liners shall ensure a minimum service life of 2 years before replacement. All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hrs. |
| 8.09.00 | The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft. |
| 9.10.00 | The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings. |
| **9.00.00** | **VERTICAL SUMP PUMPS** |
| 9.01.00 | Contractor shall provide sumps of adequate capacity in the each absorber area, limestone grinding area and gypsum dewatering area for containing the over flow |

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| | from the respective systems. Contractor shall make arrangements for pumping the drainage water back to the respective system with vertical sump pumps. Agitators shall also be provided to avoid settling of solids in the sump. Adequate redundancy in line with the standard practice adopted by the bidder shall be provided. This Clause covers the design, manufacture and erection of all vertical sump pumps for the FGD system. |
| 9.02.00 | The contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards. |
| 9.03.00 | The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal. |
| 9.04.00 | The pump shall deliver the rated flow at rated head with margins as specified in the respective clauses. The pump shall be capable of pumping of filtrate water with solid concentration upto 10% & particle lumps of 6-7mm. Sump pumps handling slurry shall be designed with a maximum concentration of 30% solid by weight. |
| 9.05.00 | The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application. |
| 9.06.00 | The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump. |
| **10.00.00** | **SLURRY & PROCESS WATER TANKS** |
| 10.01.00 | All the slurry tanks (Slurry Tanks, Filtrate Tank, Secondary hydro cyclone feed tank, vacuum receiver tank, Waste water Tank, Lime Neutralization tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replacable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. Coarse-screen(s) at suction-side of these pumps shall be provided. |
| **11.00.00** | **AGITATORS** |
| 11.01.00 | Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, limestone mill recycle tanks, limestone slurry tank, Auxiliary Absorbent tank, and sumps etc. |
| 11.02.00 | All agitators shall be designed for continuous operation unless otherwise specified. |

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| | Horizontal agitators shall be used for Absorber. Vertical agitators can also be used for Absorber, if it is only the standard & proven practice of the Contractor for the offered Absorber design. In other vessels and tanks vertical agitators are also acceptable if they are of proven make and the Bidders standard practice which can be proven by means of suitable references. The design of the agitators shall be of proven type. |
| 11.03.00 | Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc. |
| 11.04.00 | All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion. |
| 11.05.00 | The material for the shaft (which is continuously in contact with slurry) and agitator blades of the Absorber Agitators shall be made with Alloy 926 or better material. For Agitators in other tanks, agitator blades shall be made with Alloy 926 or better material & shaft can be rubber lined. This does not release the Contractor of the responsibility for selecting the correct materials. |
| 11.06.00 | Each agitator and its associated equipment shall be arranged in such **a** manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the Agitators of the absorber vessel without having to drain completely the absorber. |
| 11.07.00 | To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection. |
| 11.08.00 | Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components. |
| 11.09.00 | Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly. |
| 11.10.00 | All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally. |
| 11.11.00 | All exposed moving parts shall be covered by guards. |
| 11.12.00 | Side entry agitator shall be flange mounted. |
| 11.13.00 | The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s. |
| 11.14.00 | Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions |

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| **12.00.00** | **SLURRY LINES AND VALVES** |
| 12.01.00 | Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor may provide a recirculation line with motorized isolation valve for the above purpose. |
| 12.02.00 | All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes of size lower than 3" made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. |
| 12.03.00 | The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme. |
| 12.04.00 | The valves shall be of proven type and the contractor shall submit a detailed valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to the employer. |
| 12.05.00 | Bidder shall provide all necessary arrangements for purging & flushing of all the process pipelines, equipments etc. |
| **13.00.00** | **PROCESS WATER STORAGE TANKS & PUMPS** |
| 13.01.00 | Two (2) Process water Storage tanks (each tank catering to the requirements of all the units operating at Design Point) along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of all the units operating at Design Point) along with all necessary piping, valves, control & instrumentation to feed the clarified water shall be provided by the Contractor. Process water Storage level shall be automatically controlled at operating level by controlling the water flow from the makeup water from terminal point. The process water storage tank shall be designed to store 15 minutes of total maximum water required for the entire FGD process (including absorber system and mist eliminator washing system, limestone grinding and slurry preparation system and gypsum dewatering system, etc.) for the units operating at Design point. All the process water storage tanks shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the bidder. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tank shall receive water supplied (as identified in Subsection titled "Terminal points" in Part-A of Technical Specification) by Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. |
| 13.02.00 | 2x100% Process Water Pumps shall be provided for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & |

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| | instrumentation. Each pump catering to process water requirement of one unit. The capacity of the pumps shall be such that it shall meet the maximum process water requirement of each unit. A further 10% margin shall be provided over the above capacity for all the above pumps. |
| 13.03.00 | 2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor. Alternatively, Contractor can use process water pumps for mist eliminator washing if it is the standard & proven practice of the Contractor or its Technology Collaborator. Each pump shall cater to maximum mist washing requirement of one unit. The capacity of the pumps shall be such that the total capacity of working pumps is sufficient to meet the maximum wash water requirements of mist eliminators of the absorber. A further 10% margin shall be provided over the above capacity for all the above pumps. |
| 13.03.04 | Two (2) clarified water Storage tanks along with two numbers of 2x100 % clarified Booster water pumps from terminal point shall be provided by the Contractor. The two tanks shall be interconnected with an isolation valve. |
| 13.03.05 | 2x100% clarified water Pumps connected to each of the clarified water Storage tanks for each dewatering stream. Each pump catering to clarified water requirement of each dewatering stream. |
| 13.03.06 | The type of pumps shall be horizontal centrifugal type designed for continuous operation with semi open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent. Impeller, Wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade. Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc. |
| 13.03.07 | All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replacable chlorobuty/bromobutyl rubber lining of minimum 4 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. |
| **14.00.00** | **APPROACH and Handling Facilities** |

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| 14.01.00 | Proper approach shall be provided for access to all equipments during normal operation and maintenance. Unless otherwise specified, platforms, staircase and ladders shall follow the stipulations specified elsewhere in this specification. |
| 14.02.00 | Equipments requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5m height from the nearest platform. Below this height a vertical ladder with minimum clear width of 600 mm may also be acceptable. |
| 14.03.00 | Platform with a minimum clear width of 1000 mm shall be provided all around the lowest absorber spray levels and mist eleminators. Similar platforms shall be provided at subsequent elevations if they are more than 3000 mm apart from each other. An adequately sized manhole with platform (min. 2 sq. m) shall be provided above each spray level. Ladders/staircase shall be provided for the access to the platform. |
| 14.04.00 | The absorber slurry recirculation pumps, gypsum bleed pumps and limestone feed pumps shall be mounted on the ground level. Suitable approach and platforms shall be provided for all the valves required during regular operation. |
| 14.05.00 | A 1500 mm space shall be provided around all pumps, except absorber recirculation pumps, where a 2000 mm space shall be provided. |
| 14.06.00 | Platform with a minimum width of 1500 mm shall be provided all around the pulverizers and feeders. Approach along with suitable platforms shall be provided for ball loading hoppers. |
| 14.07.00 | A 1000 mm wide platform with suitable approach shall be provided around each hydro-cyclone. |
| 14.08.00 | A 2000 mm wide floor/platform shall be provided all around each belt filter. |
| 14.09.00 | Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more. All auxiliary structures, monorails, runway beams for all lifting tackles, hoists etc., are included in Contractor's scope of supply. Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc. |
| 14.10.00 | The regular basement floor is not acceptable in FGD area. Further local Pits/trenches shall be avoided as far as possible. |

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| 14.11.00 | Handling arrangement of milling system, Booster fans, Slurry recirculation pumps, oxidation blower, belt feeder system etc. complete with crane/monorail along with removal space for maintenance shall be provided by the Contractor. | | |
| 14.12.00 | Approach for removal of equipment for maintenance shall be provided. | | |
| 14.13.00 | All other safety requirements as per the Factories Act, National Electricity code shall be complied with while developing Layout. | | |
| 14.14.00 | Cable trenches/slits, if unavoidable, shall be provided with adequate cushioning of sand and the same shall be covered with PCC. | | |
| 14.15.00 | Each Equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of Factories Act and Statutory bodies/insurance companies. | | |
| 14.16.00 | Minimum Headroom (free height) under all floors, ducts, walkways and stairs shall be 2.50 M. | | |
| 14.17.00 | Inter-connecting pipes/cables between various facilities of FGD plant shall be routed on the steel trestles to be provided by the Contractor. The clear head room for the same shall be minimum 8 M. | | |
| **15.00.00** | **ELEVATORS** | | |
| 15.01.00 | Elevators shall be designed based on following criteria : | | |
| | (i) | Type of service | One (1) no. Passenger cum goods elevator per Absorber & for Mill Building |
| | (ii) | Design/construction/installation codes | (a) Latest edition of IS:14665 (All parts) AND also meeting any additional requirements of IS:4666, IS:1860 and IS:3534.<br>(b) Any other equivalent code, subject to Employer's approval.Load carrying capacity |
| | (iii) | | 1000 kg (minimum). |
| | (iv) | Rated speed | 1.0 m/s. |
| | (v) | Total Travel | As per FGD supplier's recommendations subject to Employer's approval. |

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| | (vi) Number of floors to be served | As per requirement and subject to Employer's approval |
| | (vii) Entrance | As per requirement and subject to Employer's approval |
| | (viii) Entrance and platform size | As per design/installation codes at (ii) above |
| | (ix) Drive/motor | As per Electrical Specifications. |
| | (x) Method of control | As per Electrical Specifications. |
| | (xi) Machine room and lift Shaft | Pressurized dust proof or Airconditioned machine room as per the requirement of lift manufacturers. |
| | (xii) Position of machine room | Directly above the lift shaft. |
| | (xiii) Power Supply | As detailed in Electrical Specification |
| 15.02.00 | Landing doors of the elevators shall have fire resistance of at least one hour. These doors shall also be smoke tight as far as possible. | |
| 15.03.00 | Construction of the elevators shall specifically meet all requirements of the codes indicated at Cl. 15.01.00 (ii) and shall have following additional features: | |
| | (i) Flooring of Cabin : | 6 mm thick Checkered Plate flooring. |
| | (ii) Design, Construction and finish of car & car door : | Car inside enclosure including inner side of door shall be of stainless steel plate of grade SS:304 of bright finish. |
| | (iii) Car entrance and landing doors : | As per BS:476 (Part 20 & 22) |
| | (iv) Door construction : | Hollow metal construction from 16 guage thick steel sheet spray painted. |
| | (v) Signals : | Car position informer in car both visual and audio, hall position indicator at all floors, telltale lights at all floors, battery operated alarm bell and emergency light with suitable battery, charger & controls. |

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| | (vi) Type of Indicators : Soft touch keys and digital luminous display in car operating panel and on all floors landings. (All fixtures in stainless steel face plates). |
| 15.04.00 | Technical requirements of Electrical items shall be as per details given in Electrical Sub-Section, Part-B. |
| 15.05.00 | Provide sound reducing material below machines in machine room. |
| 15.06.00 | Provide special corrosion resistant treatment on all elevator components. The protective treatment shall be subject to Employer's approval. |
| 15.07.00 | Elevators shall have provisions to meet following operational requirements:<br>(i) Selective collective, automatic operation with or without operator through illuminated push button station located inside the lift car.<br>(ii) Power operated with automatic opening/closing car and landing doors.<br>(iii) Two push buttons, one for upward movement and the other for downward movement at each intermediate landing, and one push button at each terminal landing shall be provided in order to call the car.<br>(iv) Push buttons shall be fixed in the car for holding the doors open for any length of the time required. |
| 15.08.00 | Fireman's switch shall be provided for each elevator. |
| **16.00.00** | **DUCT WORK AND DAMPERS :** |
| 16.01.00 | **Duct Work** |
| 16.01.01 | **Sizing Criteria :**<br>1. Allowable velocities in the duct work.<br>Maximum gas velocity shall be 15 m/sec at Design point condition. |
| 16.01.02 | **Loads for Duct and Structure Design**<br>The duct design shall take into account following loads all occurring together:<br>1. Wind loads as specified.<br>2. Dead weight including weight of insulation, lining, wash water and the vertical live load. |

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3. Ash load :

All ducts to be designed for one tenth of duct full of ash. The ash density for the purpose of loading shall be at least 1300 kg/$m^3$.

4. Expansion joint reaction.

5. Seismic Load

6. The following minimum load factors shall be applied to the design loads:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Temperature (Deg.C) | : | 27 | 38 | 93 | 149 | 205 | 260 | 316 | 321 |
| Load Factor | : | 1.00 | 1.02 | 1.12 | 1.19 | 1.25 | 1.29 | 1.34 | 1.42 |

16.01.03 **Duct Design Pressure**

All flue gas ducts shall also be designed for ± 660 mm w.g., or maximum conceivable pressure of the relevant fans, whichever is higher at 67% of yield strength of material

16.01.04 **Duct Slope**

All ducts shall have a sufficient slope with respect to horizontal so that any chance of accumulation of ash particles or water in the duct can be avoided under all normal/abnormal operating conditions. The inlet duct shall be sloped towards the absorber.

16.01.05 **Type of duct construction:**

The duct shall be of rectangular cross-section and shall be of all welded construction. For rectangular ducts following requirements shall be complied with:

a) Minimum 7 mm thick steel plates for gas ducts & Duct stiffening shall be by means of rolled sections of duct material.

b) A corrosion allowance of 1.5 mm shall be considered for stress calculation for the flue gas ducting.

c) Duct stiffening shall be by means of rolled sections. No internal stiffeners shall be used for ducts from Absorber outlet to chimney inlet.

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16.01.06 **Insulation & Lagging**

a) Thermal insulation shall be applied to all air/gas ducts to comply with the requirements of as specified at clause no 18.00.00 of this chapter.

b) Acoustic insulation shall be used, if required, in gas ducts to restrict the noise level to specified values.

16.01.07 **Specific Requirements**

a) The stiffeners provided on the ducts walls shall be of such a design and layout that no rainwater can accumulate on the duct surfaces.

b) The flanges at the bolted joints shall have adequate stiffeners to avoid damages to the flanges.

c) All necessary wall boxes and floor collars shall be provided where the ductwork pass through walls, floor and roof.

d) The floor collars shall be fitted with a high combing to prevent water and dust falling through the hole.

e) The ductwork shall be fitted with a steel hood to cover the opening.

f) Weatherproof flashing shall also be provided wherever necessary.

g) The configuration and design of ducts shall be coordinated with the pulveriser parts removal requirement.

h) Air and gas ducts shall not counter internal bracings, which cause excessive pressure drop.

i) Duct plates shall be designed for one-way beam action over stiffeners and considered fully continuous over all supports.

j) Bidder to ensure proper draining facilities for the complete system including proper drainage of acidic fluids from the ducts so as to avoid any accumulation of acidic fluids.

k) The deflection of the plate, assumed continuous, shall be less than one-half the plate thickness.

16.01.08 **Duct Work Structure**

a) Ductwork sections between expansion joints shall be investigated with regard to their ability to transmit loads to supports. Care shall be exercised to identify uplift condition.

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b) Internal stiffeners:

(i) Duct shape shall be maintained by providing internal stiffening elements at or near supports. However, these internal stiffeners shall be used, if and only if, it is not possible to provide external stiffeners.

(ii) Internal stiffening elements shall consist of trusses, preferably comprised of extra-strong steel pipes (min. dia. 76.2 mm) acting in conjunction with external stiffeners. Such internal stiffeners for the flue gas duty between boiler and ESP shall be provided with erosion protection shields.

(iii) The number of internal trusses shall be limited to the minimum required for structural integrity and shaped so as to offer least resistance to gas flow and to minimize the accumulation of fly ash in the bottom of duct.

(iv) Conceptual data of internal stiffeners of the ducting shall be furnished along with the offer.

(v) All the detailed design data shall be furnished to the Employer before the duct support column foundation data submission.

c) Corner angles shall be used on all inside corners of all ducts to provide adequate continuity.

d) Inside welds of corner angles to duct plate shall be continuous and seal welded. Where inside surface of ducts will be coated, welds shall be full throat.

e) Field welding and all connections of bracing (stiffening elements) to stiffeners shall be well designed in order to develop full strength of the members. The gusset plates shall be of 10 mm minimum thickness.

f) The duct, plates, trusses, stiffeners, bracings and ductwork shall be designed as structures in accordance with relevant Indian Standards.

g) All openings in ducts shall be reinforced for all design loads.

h) Ductwork supports may be hangers or sliding bearing, guides and anchorages. A coefficient of sliding friction of 10% can be used with self-lubricated plates such as "LUBRITE" or "MECHANITE", a coefficient of sliding friction of not less than 35% shall be used for steel-on-steel contact. The allowable bearing stress for self-lubricated plates shall be 70 Kg/sq.cm.

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16.01.09 **Fabrication Requirements**

a) Fabrication shall be as per IS specification for Design, fabrication and erection of 'Structural Steel for Building.

b) Welding shall be in accordance with Section IX of ASME code.

c) Ducts shall be strength welded and seal welded to produce a gas tight duct. Alignment holes shall be provided in mating flange sections.

d) Ducting shall be detailed and fabricated in a few pieces as practical, taking into account, shipping and erection considerations.

e) Materials improperly detailed or fabricated necessitating extra work during erection on field, shall be the responsibility of the Contractor.

**17.00.00 THERMAL INSULATION AND CLADDING**

17.01.00 Thermal Insulation along with aluminum cladding shall be provided for all the equipments/surfaces having skin temperature more than 60degree Celsius. The specification of the insulation including type, density, thickness, heat conductivity and finish shall be designed based on criteria specified below. The insulation thickness shall be designed based on following criteria.

| Criteria | | Design Conditions |
|---|---|---|
| (i) | Ambient Temperature | 45°C |
| (ii) | Surface wind velocity | 0.25 m/sec. |
| (iii) | Emissivity of Aluminium | 0.2 |
| (iv) | Cladding surface temperature | 60°C (max.) |
| (v) | Thermal conductivity of insulation material | Not less than the Maximum values as per IS:8183 |
| (vi) | Pipe/Equipment wall temperature design temperature | Maximum fluid |
| (vii) | Overall heat transfer coefficient and insulation thickness | To be calculated as per ASTM C 680-89 |

However, the minimum insulation thickness, however, shall not be less than 75 mm.

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17.02.00 Material and application of insulation material, protective cladding, wire mesh etc. shall be conforming to latest edition of following codes:

(a) IS:8183

(b) IS:3677

(c) IS:3144

(d) IS: 14164

(e) IS:280

(f) ASTM-B 209

17.03.00 Insulation material for all equipments, ducting, etc. shall conform to following requirements:

| Parameters | | Requirement | |
|---|---|---|---|
| (i) | Material | (a) | Lightly resin bonded mineral wool of best grade conforming to IS:8183. (Hand made mattresses is not acceptable). Material shall be rock wool only. Slag wool or slag wool inclusion shall not be accepted. |
| | | (b) | Lightly resin bonded glass wool mattress, having density 64 Kg/m³ (min.), self stitched in shop can also be accepted for temperature less than 400°C. |
| (ii) | Bulk density of lightly resin bonded mineral rock wool mattresses | | |
| | (a) For use upto 400°C | - | 100 Kg/m³ |
| | (b) For use above 400°C | - | 150 Kg/m³ |
| (iii) | **Physical requirements -** | | |
| | Following shall be met by testing as per relevant clauses of IS:3144. | | |
| | (a) Shot content | | 5% by weight (maxm.), size of any shot not to exceed 5 mm in diameter |

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|---|---|---|---|
| | (b) | Bulk density | To comply with 16.03.00(i) & (ii) above. |
| | (c) | Weight gain by moisture absorption | 2% (maxm.) |
| | (d) | Sulphur Content | Not exceeding 0.6% |
| | (e) | Alkalinity as percentage of $Na_2O$ | Not exceeding 0.6% |
| | (f) | Maximum oil content | Not exceeding 0.3% by weight |
| | (g) | Total carbon content | Not exceeding 0.3% by weight |
| | (h) | Settlement | Nil (When tested as per Cl. 21.1 & 21.2 of IS:3144) |
| | (i) | Handability | Fully handable, without any lump formation and disintegration of material |
| | (k) | Loss of weight after combustibility test | Not exceeding 5% by weight |

17.04.00 The Insulation mattress shall be rated incombustible when tested by the method prescribed in clause 15 of IS:3144 and shall meet the requirement of the Mercantile Marine department, Lloyd's Register of shipping, underwriter, fire hazards codes and other International standards.

17.05.00 In addition to requirements as mentioned above, insulation material (and protective covering) shall:

(a) Be fresh, incombustible, rust proof, non hygroscopic,

(b) Be capable of withstanding continuously and without deterioration the maximum temperature to which they will be subjected.

(c) Not react chemically, either to itself or with other components.

(d) Not sustain any fungi, or vermin and must not pose health hazards.

18.06.00 The Mineral wool shall:

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| | (a) Pass standard combustibility test both immediately after application and after subjected to maximum operating temperature for not less than 100 hrs.<br><br>(b) Not suffer permanent deterioration as a result of contact with moisture due to condensation and shall be free from objectionable odor.<br><br>(c) Not cause corrosion of the surface being insulated or of cladding on it under normal site conditions.<br><br>(d) Not suffer any quality deterioration under specified service conditions (both cold/hot face temp.) of use. |
| 17.07.00 | The use of insulation of finishing materials containing asbestos in any form is not permitted. |
| 17.08.00 | Insulation mattress/section shall be supplied in thickness of 25,40,50 and 75 mm. Insulation of higher thickness shall be made up in multiple layers using mattress/slabs of thickness specified above. However, if the required thickness is such that by using above mattress/slabs the calculated thickness is not achieved, the mattress/slabs in increment of 5 mm shall be acceptable for outer layers. The min. thickness however, shall not be less than 25 mm and number of layers shall be minimum and innermost layer shall be thickest. |
| 17.09.00 | **Sheathing Material**<br><br>Sheathing material for all insulated surfaces, equipments, piping etc. confirming to ASTM B-209-1060 temper H-14 or IS:737 Gr 19000/H2, shall be provided. The thickness of aluminium sheathing to be used shall be 22 SWG (0.71mm). |
| 17.10.00 | Binding and lacing wires shall be 20 SWG Galvanised Steel wire |
| 17.11.00 | All Straps and bands shall be Galvanized Steel. Bands shall be 20 mm wide and 0.6 mm thick. For securing Aluminum sheathing material, stainless steel or anodized aluminum bends shall be used. |
| 17.11.01 | Screws shall be of galvanized steel, check headed, self tapping type. Above 400 degree Celsius temperature, screws shall be stainless steel. |
| 17.12.00 | Hexagonal wire mesh netting shall be 10-13 mm aperture and atleast 0.56mm diameter conforming to following Galvanized Steel wire. |
| 17.12.01 | Non metallic components like 3 mm thick mill board, aluminum pigment sealant, white glass cloth, insulating cement, neoprene washer shall be provided. |
| 17.13.00 | **Application of Insulation** |

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17.13.01 **General**

(a) All surfaces to be insulated shall be cleaned of all foreign materials such as dirt, grease, rust etc. and shall be dry before the application of insulation.

(b) Before applying the insulation the contractor shall check that all instrument tapping, clamps, lugs and other connections on the surface to be insulated have been properly installed as per the relevant erection drawing.

(c) All flanged joints shall be insulated only after the final tightening and testing.

(d) The insulation shall be applied to all surfaces when they are at ambient temp. Ample provision shall be made for the maximum possible thermal movement and the insulation shall be applied so as to avoid breaking/telescoping due to alternate periods of expansion and contraction.

(e) All cracks voids and depressions shall be filled with finishing cement, suitable for the equipment operating temp. so as to form a smooth base for the application of cladding.

17.13.02 All the refractory and insulation materials required for complete field application of insulation, cladding etc. covered under these documents and specifications shall be furnished with the equipment. They shall conform to the requirements of the various relevant ISI standards or other approved equivalents. All items such as insulating cement, sealing material, insulation material, screws, washers, etc., needed to complete the work in the course of the application of insulation and refractory shall be furnished. All insulating materials shall be chemically inert in both the dry and wet state and shall withstand the full working temperature conditions to which they are exposed without any deterioration. The gas ducts shall be insulated with mineral wool block or mineral wool blanket and all other equipment operating at elevated temp. not enclosed in the boiler casing shall be insulated with calcium silicate blocks, mineral wool blocks or mineral wool blanket insulation.

17.13.03 **Application on Piping**

(a) All vertical pipes shall be provided with the suitable insulation supports to prevent collapsing/crushing of insulation due to its self weight. Support rings shall be provided on all vertical piping with a difference in elevation of 4 meter or above, and there shall not be more than 3 m straight length between support rings.

(b) Longitudinal joints of insulation mattress sections of horizontal piping shall be on the bottom or at the sides of the pipe.

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(c) When more than one layer of insulation mattress/section is required on piping the circumferential joints on adjacent layers shall be staggered by at least 150 mm and longitudinal joints shall be staggered by at least 50 mm.

(d) The mattress type insulation shall be formed to fit the pipe and applied with the mattress edges drawn together at the longitudinal joints and secured by lacing wire. Pipe section insulation shall be fitted on pipe using binding wires.

(e) Where insulation is applied in two or more layers each layer of mattress shall be backed with hexagonal wire mesh. For the first layer of insulation and in case of single layer insulation, hexagonal wire mesh shall be provided on both the surface of the mattress. For pipe sections, the sections shall be held in place by binding wires without any wire mesh.

(f) The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of the insulation. Any gap in the insulation shall be filled with loose mineral wool or finishing cement.

(g) Insulation mattress/section ends shall be terminated at a sufficient distance from the flanges to facilitate removal of bolts.

(h) The insulation shall be held in place by fastening over with binding wire for insulation surface with diameter upto and including 550 mm and with metal bends for insulation surfaces with diameter over 550 mm. The fastening shall be done at intervals of 250 mm except where specified otherwise. The ends of the binding wires shall be hooked and embedded in the insulation. The straps shall be mechanically stretched and fastened with metallic clamping seals of the same materials as the strap.

(i) Insulation for application on bends and elbows shall be cut into mitred segments, sufficiently short to form a reasonably smooth internal surface. After the application of insulation material place, insulating cement shall be applied as required to obtain a smooth surface.

(j) Weather hoods shall be provided for insulated piping passing through floors/walls.

(k) All pipe attachments coming on horizontal pipes, inclined pipes and bends shall be insulated along with pipe such that there will be no insulation applied to hanger rod and the component connecting hanger rod to pipe attachment. All pipe attachments exposed to weather shall be provided with weather proof covering.

(l) Upstream of all drain lines and the lines connected to steam traps, shall be insulated upto and including first isolating valve for heat conservation. Rest

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of such lines such as downstream of the drain valves, traps etc. and other lines such as safety valve discharges, vents, etc. shall be insulated for personnel protection.

17.13.04 **Application on Valves and Fittings**

(a) All valves fittings and specialties shall be insulated with the same type and thickness of insulation as specified for the connected piping with the special provisions and or exceptions as given below.

(b) All valves and flanges shall be provided with removable box type of insulation covered with box fabricated from aluminium sheets of thickness same as the connected pipe cladding. Adjoining pipe insulation shall be bevelled back to permit removal bolts and nuts or bands. The portion of the valve which can not be covered by box type insulation shall be filled by loose insulating material of packing density at least equal to that of the insulating material of adjoining pipe. The insulation for valves/flanges shall be applied after the finishing has been applied over the connected piping. The cladding shall be applied in such a manner that the bonnet flange can be exposed easily without disturbing the complete insulation and cladding.

(c) Flanges on lines having temperature upto and including 150 deg.C shall not be insulated.

(d) Union shall not be insulated.

(e) Expansion joints, metallic or rubber, shall not be insulated unless otherwise specifically indicated.

(f) Safety valves shall be insulated.

17.14.00 While applying mineral wool blanket insulation:

(a) Provide expended metal or hexagonal wire mesh on both sides for single layer mattress and on first layer in case of multilayer insulation. Subsequent layers of multilayer insulation to have only one side wire netting.

(b) The edges of adjacent blankets to be leased together, by appropriate lacing wire as per Clause 16.08.00.

(c) Any gap between joints between insulation layers shall be filled by loose mineral wool confirming to IS:3677.

(d) All insulation to be secured by 1.63 mm dia wire netting over blankets with ends of wire tightly twisted, and pressed in to insulation surface.

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(e) Impelling pins shall be placed on centers not exceeding 300 mm.

17.15.00 Flue Gas ducts with external stiffeners shall have first layer of insulation between the stiffeners and a second layer of insulation over stiffeners so that stiffeners are also insulated and a level surface is achieved. Other requirements are same as given in Clause 18.09.00.

17.16.00 **Application of Metal Cladding**

All insulated surfaces of the FGD shall be provided with metal cladding in accordance with the following requirements.

(a) All insulation procedure of metal cladding shall have prior approval of the Owner.

(b) All insulated surfaces of FGD shall be covered with aluminium cladding.

(c) Cladding for FGD components are to be finished with plain aluminium sheeting of thickness not less than the values specified. Wherever an inner casing plate is necessary to effect a gas tight enclosure, the plate shall be of mild steel of required thickness, but not less than four (4) mm suitably stiffened and supported.

(d) Cladding on straight surfaces shall be finished with aluminium sheeting of at least 20 SWG thicknesses suitably pressed along diagonals to form diamond shape or otherwise formed.

(e) Cladding for insulated circular surfaces will be constructed from aluminium sheets of thickness not less than 20 SWG.

(f) Weather proof flashings shall be installed where the panels intersect with columns and at other similar joints.

17.17.00 **Application**

All metal cladding shall be fabricated and installed to ensure a neat appearance and no open ended sections of cladding shall be left uncovered. The following provisions shall also be complied with:

(a) All closures, flashings and seals required shall be provided and installed.

(b) An asphalt and craft paper moisture barrier shall be provided to the aluminium cladding for all out door applications. Such moisture barriers shall be fixed to the inner surface of the cladding or shall be cemented to the outside surface of the insulation before application of cladding.

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| | (c) All the used in the out door cladding shall be provided with Neoprene washers.<br><br>(d) All openings and joints in outdoor cladding for piping connections, supports or access shall be suitably flashed and weather-proofed. Where such flashings or weather-proofing can not effectively control the entry of moisture, then such openings and joints shall be weather-proofed by application of aluminium pigmented sealer.<br><br>(e) Cladding on the top surfaces of the FGD, duct work and equipment shall be suitably reinforced to prevent damage by personnel walking thereon. |
| 17.18.00 | **Protection of Equipment during insulation application**<br><br>All equipment and structure shall be suitably protected from damage while applying insulation. After completion all equipment and structures shall be thoroughly cleaned of insulating materials which might have fallen on them. |
| **18.00.00** | **TYPE TEST** |
| 18.01.00 | Full scale type tests using actual equipment shall be conducted by the Contractor for the equipment mentioned in the subsequent clauses below: |
| 18.01.01 | Full range and full scale performance testing shall be conducted at shop on one number each of the following Fans as per BS 848, Part-1:<br><br>(a) Booster Fan<br><br>The performance testing at shop shall be conducted using actual fans |
| 18.01.02 | Leak tightness testing of dampers for each type and size of damper at shop to demonstrate the guaranteed gas tightness efficiency (on flow). The minimum guaranteed gas tightness efficiency of dampers shall not be less than that indicated in clause no. 3.03.08 of this Sub-Section. |
| 18.02.00 | The Bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of Bid Proposal Sheet (BPS) and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's Engineer. |
| 18.03.00 | The type tests shall be carried out in presence of the Employer's representative. Contractor shall inform the Employer about his readiness for conducting the type test and issue such notice to the Employer 30 days in advance, along with schedule of the type tests. The Contractor shall obtain the Employer's approval for the type test procedure before notifying the Employer about his readiness for conducting the type |

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| | test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out. |
| 18.04.00 | Irrespective of the requirement of conducting the type tests under this contract, The Contractor shall submit the reports of the type tests carried out for the equipments listed above in clause no. 18.01.00 and These reports should be for the tests conducted on the equipment for the model / type / size / rating to those proposed to be supplied under this contract and the test(s) should have been either be conducted at an test facility/shop/independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Employer. |
| 18.05.00 | All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. |

# SUB-SECTION-I-M2

# AIR CONDITIONING & VENTILATION SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

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| **1.00.00** | **GENERAL** |
| 1.01.00 | This section of specification covers details of system specifications, detailing the areas to be air conditioned, basis of design, brief description of the system, equipment and services to be furnished by bidder.<br>The Design, Engineering, Supply, Construction, Erection, and Testing & Commissioning of all the equipments & works listed here shall be on the basis of single point responsibility in bidder's scope of work for satisfactory completion of the system in all respect. |
| **2.00.00** | **AREAS TO BE AIR CONDITIONED** |
| 2.01.00 | The areas to be air-conditioned shall be as follows:<br>a) Air cooled condensing units (D-X type) type air conditioners with AHU of suitable capacity with 100 % redundancy ( as per actual heat load calculation ) shall be provided for each FGD Control room building and ZLD control room building (if provided).<br>b) Cassette and Hi-wall Air-conditioners for Other auxiliary control room /control room buildings not listed above but covered in the scope of Bidder. |
| **3.00.00** | **AREAS TO BE VENTILATED** |
| 3.01.00 | (i) Unitary Air Filtration (UAF) units of min. capacity 75,000 m3/hr or capacity calculated considering 8 air changes per hour whichever is higher, shall be provided for Non-Air Conditioned areas of FGD and ZLD (as provided) control building (e.g. Switch gear rooms, cable galleries, etc.)<br>(ii) Mechanical Ventilation (using Roof extractors/ Supply and/or Exhaust fans) shall be provided for various other areas/buildings in the scope of bidder as under:<br>a) Grinding system building<br>b) Gypsum dewatering building<br>c) Recirculation pump & Oxidation blower/compressor building.<br>(iii) Toilets etc in above building (i) & (ii). Any other area not listed above but covered in the scope of Bidder.<br>iv) For other miscellaneous areas/ buildings not listed above but covered in the scope of Bidder, mechanical type ventilation system using Supply and/or exhaust air fans/ roof exhausters shall be provided. |
| 3.02.00 | All non-air conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers as detailed below: |

| S.No | Area | Type of Ventilation system |
|---|---|---|
| (i) | General area like pump house, buildings etc | Combination of Supply air fan & Exhaust air fans |
| (ii) | MCCs and Switchgear room etc | Supply air fan & Back draft dampers |
| (iii) | Battery rooms & Oil rooms and fumes/odor generates | Combination of Supply air fan & Exhaust air fans. Motors shall be flame proof. |
| (iv) | Toilet/pantry etc | Propeller type exhaust air fan |

**4.00.00 EQUIPMENT DESCRIPTION – AIR CONDITIONING SYSTEM**

4.01.00 **Condensing Unit (Air-Cooled D-X type)**

Condensing unit

Type : Air cooled scroll type

Vibration isolators : Steel spring / Neoprene rubber cushy foot type with isolation efficiency not less than 85%.

Compressor

Type : The Compressor shall be scroll, serviceable, either hermetic type or semi-hermetic type with automatic capacity control (minimum 3 steps).

Type of drive : Motor driven, direct or through V-belt.

Refrigerant : The refrigerant shall be R-134a/ R-410A/R-407C or any other environment friendly refrigerant.

Accessories : High/Low pressure cutouts, oil pressure switches, relief valves, pressure gauges at each stage, lube oil and control oil pressure gauges, suction & discharge stop valves, Muffler, Crank case heaters, oil filters, magnetic oil separators, temperature indicators for lube oil/heaters, oil level indicators, safety thermostat for crank case heater, vibration isolators, etc.

Motor Rating : 10% more than the power required by the compressor at 50 deg C design ambient temperature.

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|---|---|---|---|
| | Capacity | : | Minimum capacity shall be suitable for the identified/selected at evaporating temperature and condensing temperature and shall be indicated. |

4.02.00 **Air Handling Unit (AHU)**

4.02.01 Each AHU shall consist of casing, fan impeller section, cooling coil section, damper section, steel frame with anti vibration mountings (AVMs) having minimum 85% vibration dampening efficiency and flame retardant, water proof neoprene impregnated flexible connection on fan discharge. Isolation dampers at the suction and discharge of each AHU shall be provided, in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) and absolute (HEPA type) filters (wherever applicable) at the discharge of each individual AHU, and heater section in the common discharge of AHUs shall be provided.

4.02.02 The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24g) galvanized steel sheet (thickness of galvanization as per manufacturer's standard) , with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements shall be provided to give structural strength to prevent any deformation/buckling.

4.02.03 Sloping condensate drain pan shall be made of minimum 1.2 mm thick Stainless Sheet Steel. It shall be isolated from bottom floor panel through 25mm thick heavy duty treated for Fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.

4.02.04 Cooling coil (min. 4 row deep) shall be made of seamless copper tubes with aluminium fins firmly bonded to copper tubes and shall be provided with suitable drains and vents connections.

4.02.05 All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.

4.02.06 **Centrifugal fan for AHU**

| | | | |
|---|---|---|---|
| a) | Fan Type | : | Double Width Double Inlet (DWDI) Centrifugal Type |
| b) | Fan impeller | : | Backward curved blades |
| c) | Casing material | : | GI /Mild steel with minimum thickness of 3 mm. |
| d) | Impeller material | : | Carbon steel |
| e) | Shaft | : | EN 8 Steel |

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| | f) | Fan bearings | : | Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours. |
| | g) | Critical speed | : | First critical speed of rotating assembly shall be at least 25% above the operating speed. |
| | h) | Drive | : | Motor driven with removable belt guard. Motor driven with removable belt guard. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point. |
| | i) | Fans | : | For AHUs of capacity 50,000 CMH and above, Bidder may offer two (2) Nos. centrifugal fans of equal capacity for each AHU provided all such AHUs are accommodated within the space identified by the Employer. |

4.02.07 **Mixing Box:**

Mixing box shall be complete with fresh and return air dampers. Mixing box shall be provided whenever the return air is ducted back to the AHU. Further, wherever return air is led back directly to AHU room, no mixing box is required.

4.02.08 **Pan Humidifier:**

Pan humidifier shall be made of 22 gauge SS 304 tank, duly insulated with 25 mm thick resin bonded fiber glass insulation (min. 24 Kg/m3 density) with 0.5 mm GSS cladding. The humidifier shall be complete with stainless steel immersion heaters, safety thermostat, float valve with stainless steel ball, sight glass, overflow and drain connections, steam outlet nozzle and float switch. Step controller shall be provided for switching on / off heater banks as per system requirement.

**4.03.00 HI-WALL SPLIT/CASSETTE AIR-CONDITIONERS**

4.03.01 Hi-wall Split/cassette air conditioners shall in general consist of the following:

i) Casing

ii) Hermetically sealed rotary/scroll Compressor

iii) Condenser and condenser cooling fan

iv) Evaporator along with fan

v) Cooling coil

vi) Filters

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| | vii) Piping, valves, refrigerant strainer, etc.<br>viii) Controls, instruments, control panel/starter panels.<br>ix) Vibration isolator pads, etc as required.<br>x) Refrigerant as per manufacturer practice. |
| 4.03.02 | Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type):<br>The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view.<br>Unit shall have four way supply air grills on sides and return air grill in center.<br>Each unit shall have high lift drain pump and very low operating sound. |
| 4.04.00 | **SPLIT/PACKAGED AIR CONDITIONERS** |
| **4.04.01** | Split/packaged air conditioners shall in general consist of following:<br>I. Casing<br>II. Compressor<br>III. Condenser<br>IV. Evaporator and condenser cooling fan<br>V. Cooling Coil<br>VI. Filters<br>VII. Piping, Valves, refrigerant strainer etc.<br>VIII. Control, instruments, control panel/starter panels.<br>IX. Vibration isolator pads, ducting (if applicable) etc as required. |
| **5.00.00** | **EQUIPMENT DESCRIPTION - VENTILATION SYSTEM** |
| **5.01.00** | **Unitary Air Filtration** |
| 5.01.01 | Each modular unitary air filtration shall consist of Casing, Tanks, Fans, Distribution plates, Moisture eliminator and water repellant type nylon filter with frame and support, Header and standpipe with support, Spray and flooding type nozzle. Screen type suction strainer, Pumps, Necessary controls & Instrumentation, and all other required accessories. |
| 5.01.02 | The housing/ casing of air washer unit shall be double skin construction. Double skin panels shall be made of 22G galvanized sheet on outer side and 20G galvanized sheet inside with 25mm thick polyurethane foam insulation of minimum 38 kg/cub. Mtr. Density in between. Frame work for section shall be joined together with soft |

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| | rubber gasket in between to make the joints air tight. The entire fan section shall be mounted on rolled formed GSS channel frame work. |
| 5.01.03 | The unitary air filtration tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the tank shall be spray galvanized **(minimum 60 microns DFT).** Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe. |
| 5.01.04 | The distribution plate shall be fabricated out of 18G galvanized steel sheets & galvanized steel angle supports with minimum 50% free area. |
| 5.01.05 | Unitary air filtration shall be one-bank construction. All header and stand pipes shall be galvanised. Cat walks of suitable width shall be provided for maintenance of nozzle, filter etc. |
| 5.01.06 | The spray nozzles shall be of brass or bronze with chrome plating and shall be self cleaning type. The nozzle shall be designed to produce fine atomised spray and shall be properly spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm2. |
| 5.01.07 | The eliminator plates shall be of 24G thick GS sheets class 275 or from 100% virgin PVC of minimum finished thickness of 2 mm. The eliminator section made of GSS shall have minimum six bends. The PVC eliminators shall be UV stabilised using Titanium di-oxide and shall withstand the weathering test as per IS:4892 for 500 hrs. Type test report of the compound testing carried out in any reputed laboratory shall be submitted for approval. All supports, tie rods and space bar shall be of either galvanised steel or PVC construction and shall be complete with suitable drip tray and drain pipe. |
| 5.01.08 | Air tight inspection doors of suitable size shall be provided for suction chamber. Spray chamber and fan suction for easy accessibility and maintenance and a water marine light be provided for each unitary air filtration. |
| 5.01.09 | Suitable number of brass screen shall be provided in the air washer tank to arrest the dirt entering the circulating water pump suction. Suitable GI grid shall be used inside the screen for reinforcement. |
| 5.01.10 | The specification for centrifugal fans shall generally be as indicated below. However, the fan shall be of DIDW type for UAF unit. |
| 5.01.11 | Saturation efficiency of Unitary Air Filtration units shall be minimum 60%. |
| **5.02.00** | **Centrifugal Fan** |
| 5.02.01 | The casing shall be of welded construction fabricated with heavy gauge galvanised sheet steel or MS sheet with spray galvanization (**minimum** 60 micron DFT). The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required.<br><br>The impeller shall have die-formed backward-curved blades tie welded to the rim and back plate to have a non overloading characteristic of the fan. Rim shall be spun to have a smooth contour. If required intermediate stiffening rings shall be |

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| | provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts. |
| 5.02.02 | The bearing shall be self aligning, heavy duly ball, roller or sleeve bearing. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside. |
| 5.02.03 | Inlet guard shall be spun to have a smooth contour. Inlet screen, if provided, shall be of galvanised wire mesh of 25 mm square. |
| 5.02.04 | Base plate with necessary number of spring type vibration isolators or ribbed neoprene rubber pad or cushy foot mounting shall be provided. The vibration isolators should have a minimum of 70% efficiency. |
| 5.02.05 | The first critical speed of the rotating assembly shall be at least 25% above the opening speed. |
| 5.02.06 | The fans shall be provided with V-belts and sheaves. All belts shall be sized for 150% rated HP. All V-belt shall be equipped with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point. |
| **5.03.0** | **Roof Ventilators (If applicable)** |
| 5.03.01 | The roof extractors shall be “COWL” type. |
| 5.03.02 | Impeller shall be of axial flow type, cast Aluminium in one piece and dynamically balanced. Casing shall be heavy gauge sheet steel construction of 3 mm thick for impeller upto 750 mm diameter and 5 mm for fans with impeller of diameter 750 and above. In casing, access door with locking arrangement be provided. |
| 5.03.03 | The cowl shall be designed for weather protection of the fan also inside of the roof on which the extractor is installed. Galvanised bird screen of 15 mm Square be provided with the cowl. All accessories, steel supports as required will be provided. |
| 5.03.04 | The speed of the fan be limited as per limitation given above for axial fans. |
| 5.03.05 | All accessories rain protection exhaust hood, transformation piece, vibration isolators, steel supports vibration isolators, bird screen, etc. as required shall be provided. |
| 5.03.06 | The vibration level for fans shall be as per ISO: 14694. |
| **5.04.00** | **Centrifugal Pumps** |
| | a) Type : Horizontal Centrifugal, Axially or radial split type casing pump or end suction, top discharge horizontal centrifugal pump |
| | b) Impeller : Closed type |
| | c) Material of Construction |
| | i) Casing : 2% Ni Cast Iron : IS:210 Gr. FG-260 |

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|---|---|---|---|
| | ii) Impeller | : | Bronze IS:318 Gr-2 |
| | iii) Wearing rings | : | Bronze |
| | iv) Shaft | : | SS 316 |
| | v) Shaft sleeve | : | SS 316 |
| | vi) Lantern ring | : | Brass / Bronze |
| | vii) Packing | : | Asbestos free |
| | viii) Base Plate | : | Carbon steel as per IS:2062 |
| | ix) Speed | : | Maximum 1500 rpm |
| | x) Other requirements | : | To refer to **Annexure-I** titled "Horizontal Pumps" of this sub section. |

**5.05.0 Axial Fans**

5.05.01 These fans shall have fixed / variable pitch cast aluminum blades of aerofoil design.

5.05.02 The fan casing shall be of heavy gauge sheet steel construction.

5.05.03 Necessary rain protection cowl, inlet and outlet cones, bird protection screen, adjustable damper, vibration isolators, back draft dampers etc. shall be provided.

5.05.04 The speed of the fan shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1400 rpm for fan with impeller diameter 450 mm or less. However for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1440 rpm for fan with impeller diameter of above 450 mm and 2800 rpm for fan with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be atleast 25% above the operating speed.

5.05.05 All other accessories like supporting structure etc. as required shall be provided.

5.05.06 Fans of capacity 1000 $m^3$/hr & lower shall be of propeller exhaust type.

**6.00.00 BALANCE EQUIPMENT SPECIFICATION**

6.01.00 **Material of Construction for Piping & Fittings**

| | | | |
|---|---|---|---|
| a) | Piping for Chilled and Condenser water lines | : | Heavy grade-IS:1239 or Equivalent upto150 NB and IS:3589 or Equivalent for pipes beyond 200 NB with thickness as indicated in **Annexure-II** |
| b) | Refrigerant piping : | : | Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade). |
| c) | Drain piping | : | Same as (a) above & galvanized as per IS:4736. |

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| | d) Fittings : 1) The steel fittings shall conform to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above.<br>2) For sizes 50 NB and below, the material shall conform to ASTM A-105.<br>3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5<br>4) For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends shall be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections shall not be more than 22.5 deg and shall be as per BS:2633/BS:534.<br>5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5 |
| 6.02.00 | **VALVES** |
| 6.02.01 | Valves shall have full sizes port and suitable for horizontal and as well as vertical installation. |
| 6.02.02 | Valves for regulating duty shall be of globe type suitable for controlling throughout its lift. |
| 6.02.03 | All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge. |
| 6.02.04 | Valves shall be furnished with back seating arrangement for repacking while working under full working pressure. |
| 6.02.05 | Manual gear operators be provided for valves of size 200 NB and above. |
| 6.02.06 | All valves shall be supplied with companion flanges, nut, bolts & washers, etc. |
| 6.02.07 | The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent. |
| 6.02.08 | Gate valves shall be of Cast Iron body (confirming to IS:210 Gr FG 220/equivalent) for sizes 65 NB and above conforming to fIS :14846. Gun Metal construction for sizes less than 65NB shall be as per IS:778. Butterfly valves shall conform to latest revision of BS:5155 or equivalent standard of required class/rating. |
| 6.03.00 | **AIR FILTERS** |
| 6.03.01 | **Pre Filter**<br>1) Type : Flange / Cassette<br>2) Pre-filter shall contain washable non-woven synthetic fiber or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium |

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expanded metal on exit side or G.I. wire mesh on both sides.

3) **Other requirements : (as applicable)**

a) Suitable aluminium spacers be provided for uniform air flow;

b) Casing shall be provided with neoprene sponge rubber sealing.

c) Capable of being cleaned by water flushing.

d) Density of filter medium shall increase in the direction of air flow in case of metallic filter.

e) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.

4) **Efficiency :**

Average arrestance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 – 76 / EN-779.

5) Minimum thickness : 50 mm

6) Face Velocity : Not more than 2.5 m/sec.

7) Pressure drop : Initial pressure drop - Not to exceed 5.0 mm WC at rated flow.

Final pressure drop - Upto 7.5 mm WC.

8) Location : a) At the suction of each AHUs

: b) At the suction of each Fresh air fan

6.03.02 **Fine Filters (Microvee type)**

1) Type : Flange / Cassette

2) Fine filter shall contain washable non-woven synthetic fibre or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.

3) Other requirements :

a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame.

b) Capable of being cleaned by air or water flushing.

c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.

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| | 4) Efficiency | : | Average arrestance > 90% when tested in accordance with BS:6540/ASHRAE–52-76 / EN-779. |
| | 5) Minimum thickness | : | 150 mm or 300 mm. |
| | 6) Face Velocity | : | Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm. |
| | 7) Pressure drop | : | Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC. |
| | 8) Location | : | i) At the discharge of each individual AHU.<br>ii) At the discharge of each Fresh air fan. |

6.04.00 **LOW PRESSURE AIR DISTRIBUTION SYSTEM**

6.04.01 Material of air distribution system shall be through galvanized steel sheet (Conforming to Class 275 of IS :277) or Aluminium alloy (grade 19000 / SIC or 3100 / NS3 of IS:737). GI Sheets should be galvanized and galvanizing shall be of 275 gms/sq.m. (total coating on both sides) both for site fabricated and factory fabricated ducts.

6.04.02 **Thickness of rectangular ducts shall be as follows:**

| Larger Dimension of duct (mm) | Thickness of GI sheet(mm) | Thickness of Aluminium sheet (mm) |
|---|---|---|
| up to 750 mm | 0.63 (24 G) | 0.80 |
| 751 to 1500 | 0.80 (22 G) | 1.00 |
| 1501 to 2250 | 1.00 (20 G) | 1.50 |
| 2251 & above | 1.25 (18 G) | 1.80 |

6.04.03 **Thickness of round ducts shall be as follows:**

| Diameter of Round duct (mm) | Thickness of GI sheet(mm) | Thickness of Aluminium sheet (mm) |
|---|---|---|
| 150 to 500 | 0.63 | 0.80 |
| 501 to 750 | 0.80 | 1.00 |
| 751 to 1000 | 0.80 | 1.00 |
| 1001 to 1250 | 1.00 | 1.50 |
| 1251 & above | 1.25 | 1.80 |

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| 6.04.04 | **Duct Fabrication and Supports:**<br><br>a) Duct fabrication shall be as per the latest relevant BIS/SMACNA standard.<br><br>b) Ducts for A/C system may be **site fabricated or factory fabricated**.<br><br>c) The ducts routed inside the buildings with larger side greater than 2250 mm shall be supported by 16mm MS rods and 50x50x3 mm MS double Angles while those below 2250 mm shall be supported by 10mm MS Rods and 40x40x3 MS angles. The duct supports shall be at a distance of not more than 2000 mm for A/C system. The MS rods for these ducts routed inside the building shall be hung from the existing floor beams/wall beams/roof beams/columns with provision of necessary auxiliary or special steel members or by hooks or can be provided by dash fasteners fixed to the ceiling slab. No supports shall be taken from horizontal/vertical bracings of the structures. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required shall be provided by the bidder. Where ever ducts are running outside the building and or at locations where it is not possible to support the ducts from ceiling/floor due to non-availability of the same, the base steel frame/truss work and other auxiliary steel members, hooks, rods, etc. for supporting the duct work shall also be provided by the Bidder.<br><br>d) Where the sheet metal duct connects to the intake or discharge of fan units a flexible connection of fire retarding, at least 150 mm width shall be provided of closely woven, rubber impregnated double layer asbestos/canvas or neoprene coated fibre glass.<br><br>e) All curves, bends, off-sets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same velocity as in the main duct to which the branch duct is connected.<br><br>f) Wherever duct passes through a wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space.<br><br>g) Wherever pipe hangers or rods pass through the ducts, light and streamline easement around the same shall be provided to maintain smooth flow of air.<br><br>h) Access doors shall be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash of approved type. All doors shall be set so as to flush with insulation or plaster finish on the duct. |
| 6.04.05 | Splitters and dampers shall be provided for equipment/area isolation and for proportional volume control of system. The same shall be minimum 16 gauge GS |

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sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.

6.04.06 **Factory fabricated ducts :**

i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I.

ii) Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA)

iii) All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory fabricated by utilizing the machines and processes as specified in SMACNA or by equivalent technology. In equivalent method, the fabrication shall be done by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply:

a) Coil lines to ensure location of longitudinal seams at corners/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.

b) All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.

c) All edges to be machine treated using lock formers, flangers and roll-bending for turning up edges.

d) Sealant dispensing equipment should be used for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified. Sealing of longitudinal joint is compulsory for the ducts over 2" w.g. static pressure

iv) All transverse connectors shall be 4-bolt slip-on flange system with built-in sealant, if any. To avoid any leakage additional sealant shall be used.

v) Factory fabricated ducts shall have the thickness of the sheet as follows:

| Sl.No. | **Size of Duct** | **Sheet Thickness** |
|---|---|---|
| i) | upto 750 mm | 0.63 mm |
| ii) | 751 mm to 1500 mm | 0.80 mm |
| iii) | 1501 mm to 2250 mm | 1.00 mm |
| iv) | 2251 mm and above | 1.25 mm |

**6.05.00 Diffusers, Grills & Dampers :**

6.05.01 Supply air diffusers/grills with factory fitted volume control dampers be provided for all air-conditioned areas.

6.05.02 Return air diffusers of air-conditioned areas shall be without volume control dampers.

6.05.03 The diffusers/grills shall be of extruded Aluminum of minimum 1.2 mm thick with powder coating. The colour of power coating shall be as per the interior décor.

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| 6.05.04 | Supply air grills shall be of double deflection type and return air grills shall be of single deflection type. |
| 6.05.05 | All volume control (VC) damper shall be operated by a key from the front of the grills/diffusers and shall be of GI sheet. |
| 6.05.06 | The thickness of VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 22 gauge. |
| 6.05.07 | Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required shall also be provided. |
| 6.05.08 | Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes. |
| 6.05.09 | All plenum chambers of connections to fans, dampers etc shall be constructed in 18 gauge GS sheet and supported on MS angle frames. |
| 6.05.10 | All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer. |
| **6.06.0** | **Thermal and Acoustic Insulation** |
| **6.06.01** | **A) <u>Application with Glass Wool / Rockwool</u>**<br>(i) All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products / Loid bond 83 or Equivalent) be applied @ 1.5 Kg /Sqm on the surface.<br>(ii) Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber / Rockwool) shall be struck to the surface. All the joints shall be sealed with bitumen.<br>(iii) Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side or alternatively aluminum foil can be used which can come as lamination over insulation.<br>(iv) Insulation Finish of types specified under shall be provided thereafter..<br><br>**B) <u>Application with Nitrile Rubber</u>**<br>(i) All surfaces to be insulated shall be properly cleaned.<br>(ii) A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces.<br>(iii) Insulating material shall than be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within.<br>(iv) Two layers of Glass Cloth with a suitable adhesive as SR 998 or equivalent shall be then applied over the insulating material to avoid surface weathering.<br>**C) <u>Application with Polyurethane Foam & Polyisocyanurate Foam</u>**<br>i) All surfaces to be insulated shall be cleaned. |

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ii) A suitable adhesive such as CPRX or Loid Bond 83 or equivalent shall be applied over the surface to be insulated and insulation material surfaces.

iii) Insulating material with aluminum foil lamination shall then be pasted onto the surface in a manner to avoid stretching and any air entrapment within.

iv) Two layers of Glass Cloth with a suitable adhesive as Loid Bond 130 shall be then applied over the insulating material, to avoid surface weathering.

v) Insulation Finish of types specified under shall be provided thereafter.

**6.06.02 Type of Insulation & Finish**

| Sl. No. | Surface | Insulation Material | Insulation Form | Thick (mm) | Finish (mm) |
|---|---|---|---|---|---|
| 1. | Supply & return air duct of AC System | Resin bonded glass wool or | Roll /Slab | 50 | F-3 |
| | | Closed Cell Elastomeric Nitrile Rubber | sheet | 19 | As per manufacturer std. |
| | | or Polyisocyanurate Foam | Slab | 30 | F-3 |
| 2. | Refrigerant (Suction and liquid lines) | Closed Cell Elastomeric Nitrile Rubber | tube | 19 | As per manufacturer std. |
| | | or Rigid Polyurethane Foam | Pipe Section | 50 | F-1 (a) |
| 3. | AHU drain pipe | Closed Cell Elastomeric Nitrile Rubber | tube | 19 | As per manufacturer std. |
| | | or Rigid Polyurethane Foam | Pipe Section | 50 | F-1 (a) |
| 4. | AHU condensate pan (insulation if required) | Mineral wool or resin bonded glass wool | Slab | 25 | As per manufacturer std. |

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| Sl. No. | Surface | Insulation Material | Insulation Form | Thick (mm) | Finish (mm) |
|---|---|---|---|---|---|
| 5. | Chilled water piping, valves & specialties | Resin bonded Mineral wool or resin bonded glass wool | Pipe section | 75 | F-1/F-3 |
| | | or<br>Rigid Polyurethane Foam | Pipe Section | 50 | F-3 |
| 6. | Chiller (insulation if required) | ---------- As per manufacturer std.---------- | | | |
| 7. | Chilled water pumps | Resin bonded Rockwool wool or resin bonded glass wool | Slab | 75 | F-1/ F-3 |
| | | or<br>Rigid Polyurethane Foam | Slab | 50 | F-3 |
| 8. | Expansion tank with associated piping | Resin bonded Rockwool wool or resin bonded glass wool | Slab/ Pipe section | 75 | F-1/ F-3 |
| | | or<br>Rigid Polyurethane Foam | Slab | 50 | F-3 |
| 9. | Acoustic insulation of duct | Resin bonded Glass wool | Slab | 25 | As per specifications |
| 10. | Exposed air duct | Resin bonded Glass wool/Rockwool | Roll/Slab | 50 | F-4 |
| | | or<br>Polyisocyanurate Foam | Slab | 50 | F-4(a) |

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6.06.03 **Specification for insulation shall be as follows: -**

| Insulation Material | Code | Thermal conductivity (w/m/$^{o}$C | Density Kg/m$^3$ |
|---|---|---|---|
| Resin bonded glass wool | IS:8183 | 0.049 at 50$^{o}$C<br><br>0.043 at 50$^{o}$C | i) 24 (For Glass wool)<br>ii) 48 (For Rockwool)<br>iii) 48(For acoustic insulation) |
| Mineral wool pipe section. Min.Gr.2 | IS:9842 | 0.043 at 50$^{o}$C | 144 |
| Closed Cell Elastomeric Nitrile Rubber | | 0.036 at 20$^{o}$C | 40 – 60 |
| Polyurethane Foam<br><br>Polyisocyanurate Foam | IS12436 | 0.03 at 50 $^{o}$C<br><br>0.03 at 50 $^{o}$C | 34 $\pm$ 2<br><br>34 $\pm$ 2 |
| Note : Insulation used for HVAC application shall be CFC/HCFC free | | | |

6.06.04 **The specification for various finishes shall be as follows**

| | |
|---|---|
| a) | **Finish F-1 ( with Resin Bonded Glass Wool/Resin Bonded Mineral Wool)** |
| | Step-1 Wrapping of Poly-Bonded Hessain (PBH – to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound. |
| | Step-2 The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire. |
| | Step-3 Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application. |

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|---|---|---|
| | aa) | **Finish F-1(a) (With Polyurethane Foam & Polyisocyanurate Foam)**<br>Wrapping of two layers of 7 mil 10 x 10 mesh glass cloth dipped in suitable adhesive such as SR 998 or Loid Bond 130 equivalent |
| | b) | **Finish F-2**<br>Step-1 Insulation shall be covered with 500g polythene with 50mm overlap and sealing of overlap with synthetic adhesive like CPRX/ Loid Bond 83 or Equivalent compound. |
| | | Step-2 Same as Step-2 of Finish F-1 above. |
| | | Step-3 Same as Step-3 of Finish F-1 above. |
| | c) | **Finish F-3**<br>Step-1 Same as Step-1 of Finish F-2 above |
| | | Step-2 The polythene shall be covered with 26 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100 mm. |
| | d) | **Finish F-4**<br>Step-1 Same as Step-1 of Finish F-1 above.<br>Step-2 Same as Step-2 of Finish F-1 above.<br>Step-3 Same as Step-3 of Finish F-1 above.<br>Step-4 Application of 3 mm thick coat of suitable water proofing compound and wrapped with fibre glass RP tissue followed by final coat of 3 mm thick water proofing compound over the RP tissue.<br>Step-5 After the above treatment, 22G Aluminium sheet cladding, properly stiched at all joints shall be provided over the external surface. |
| | dd) | **Finish F-4(a) (With FR Closed Cell Chemically Cross Linked Polyethylene)**<br>Application of aluminium sheet 22G cladding to be provided over the XLPE insulating material. Cladding sheet is held in position with SDST screws @ 150 mm C/c over tongue-in-groove joints applied with a felt for sealing joint against water ingress.<br>All sheet joints to be done in a manner to shed water. |

6.06.05 For all inspection covers and hatches on equipment, pump casing, valve bodies and flanges (100 mm and above), insulation shall be applied so as to facilitate removal without minimum damage to the insulation by encasing the insulation in 24 gauge GI box or 22 gauge Aluminium sheet metal boxes which are bolted together around the equipment. However continuity of the vapour seal between the static and removable portions of the insulation is to be maintained.

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| 6.06.06 | **ACOUSTIC INSULATION**<br>a) All ducts up to a distance of 5 meters from AHU shall be acoustically lined from inside with 25 mm thick resin bonded glass wool of 48 Kg/Cu.M. density and 30 gauge perforated aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre-to-centre distance. Insulation shall be fixed on wooden frame of 600 x 600 mm dimension.<br>b) Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated aluminium sheet. Application of acoustic insulation shall be inline with the requirements specified above. |
| **7.00.00** | **PLANT CONTROL** |
| 7.01.00 | Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer. The descriptions in the sub-sections of the control & instrument sections shall also be referred to. |
| 7.02.00 | **Control Scheme for Air-Conditioning System** |
| 7.02.01 | Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning and ventilation system as per manufacturer's standard practice. Control and monitoring of air conditioning and ventilation system from FGD and ZLD (as provided) control system is also acceptable. |
| 7.03.00 | **Air Handling Unit**<br>a) Humidity sensor and gyserstat located in the return air duct shall actuate the PAN humidifier to obtain the desired degree of humidification.<br>b) Humidity and temp. sensor shall be provided and interlocked in steps with winter heater / re-heater / strip heaters for monsoon and winter re-heating or heating as the case may be.<br>c) Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat - located in front of the each heater in the supply air duct)<br>d) AHU shall be started either locally or from the main control room of AC system by means of Remote / Manual selection facility.<br>e) The closure of fire dampers, automatic tripping of AHU fans and fresh air fans shall be interlocked with Fire Detection System. |
| 7.05.00 | **Cassette /Hi-wall Split Air Conditioners**<br>Control and interlocks for these type of units shall be as per manufacturer's standard practice. |
| 7.06.00 | **Miscellaneous Control Requirements**<br>a) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
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| | b) Relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall made be available in FGD and ZLD (as provided) control system |
| **8.00.00** | **PAINTING:** |
| 8.01.00 | All the Equipments shall be protected against external corrosion by providing suitable painting. |
| 8.02.00 | The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting, etc. as per the agreed procedure. |
| 8.03.00 | For all the steel surfaces (external) exposed to atmosphere (outdoor installation), one(1) coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied. |
| 8.04.00 | For all the steel surfaces inside the building (indoor installation), One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat shall be applied. |
| 8.05.00 | For centrifugal fans - Casing shall have hot dip/ spray galvanization (**minimum** 60 micron DFT). |
| 8.06.00 | However, for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and colour with glossy finish of minimum thickness of 25 microns. |
| **9.00.00** | **CODES & STANDARDS** |
| 9.01.00 | The design, manufacture and performance of equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipments are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility. |
| 9.02.00 | Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard. |

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**Annexure –I**

## GENERAL SPECIFICATION FOR HORIZONTAL PUMPS

1) **SCOPE**

This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

2) **CODES AND STANDARDS**

The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

3) List of Applicable Standards.

IS : 1520 : Horizontal Centrifugal Pumps for clear cold fresh water

IS : 5120 : Technical requirements of roto dynamic special purpose pumps

API : 610 : Centrifugal pumps for general refinery service.

IS : 5639 : Pumps Handling Chemicals & corrosion liquids

IS : 5659 : Pumps for process water

HIS : Hydraulic Institute Standards, USA

ASTM-1-165-65 Standards Methods for Liquid Penetration Inspection.

In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

4) **DESIGN REQUIREMENTS**

a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within ± 10% of the rated design flow as indicated in data sheets.

b) The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of about 15% more than the design head.

c) Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

d) Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

| Speed | Antifriction Bearing | Sleeve Bearing |
|---|---|---|
| 1500 rpm and below | 75.0 micron | 75.0 micron |
| 3000 rpm | 50.0 micron | 65.0 micron |

The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface.

e) The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

f) The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

g) Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

h) The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

5) **DESIGN CONSTRUCTION**

a) Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.

**Annexure –I**

b) **Pump Casing**

Pump casing shall have axially or radially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

c) **Impeller**

Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled.

The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

d) **Impeller/Casing Wearing Rings**

Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

e) **Shaft**

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

f) **Shaft Sleeves**

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.

Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

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**Annexure –I**

g) **Bearings**

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

h) **Stuffing Boxes**

Stuffing box design should permit replacement of packing without removing any part other than the gland.

Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

i) **Mechanical Seals**

Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

j) The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

k) **Pump Shaft Motor Shaft Coupling**

The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

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**Annexure –I**

l) **Base Plate**

A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

m) **Assembly and Dismantling**

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

n) **Drive Motor (Prime Mover)**

The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

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## ANNEXURE-II

**PIPING THICKNESS:** Pipes for sizes 200 NB & above shall confirm to IS: 3589 Grade 410. The thickness as mentioned below are the minimum specified nominal thickness as per IS: 3589. Tolerance as code shall be applicable.

| Nominal pipe Size (mm) | Outside Diameter (mm) | Wall Thickness (mm) |
|---|---|---|
| 200 NB | 219.1 | 4.5 |
| 250 NB | 273 | 5 |
| 300 NB | 323.9 | 5.6 |
| 350 NB | 355.6 | 5.6 |
| 400 NB | 406.4 | 6.3 |
| 450 NB | 457 | 6.3 |
| 500 NB | 508 | 6.3 |
| 600 NB | 610 | 6.3 |

# SUB-SECTION-I-M3

# COMPRESSED AIR SYSTEM

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
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| | **COMPRESSED AIR SYSTEM** |
| **1.00.00** | **SYSTEM DESCRIPTION** |
| 1.01.00 | The compressed air system shall consist of Air compressors & their motor drives, Air Drying (ADPs) Plants, air receivers for each Air compressors, instrumentation and control, control panels, compressed air piping, Instrument Air Piping network, service air piping network and Unit Instrument Air receivers (One for each unit) |
| 1.02.00 | A dedicated air receiver shall be provided near ZLD Plant to meet the instrument /service air requirement of ZLD Plant if the location of ZLD Plant is far away from compressor house. |
| 1.03.00 | Air from air compressors shall be dried in respective Air Drying Plants in compressor house and delivered to the Air receivers. From the Compressed air piping header at the downstream of Air receivers, one common header to be provided to meet the service and instrument air requirement for FGD and ZLD Plant (as provided) |
| **2.00.00** | **SCREW AIR COMPRESSORS** |
| | The minimum requirements of design and construction features of various components of Compressed air system (screw type air compressor, air dryer, air receiver, etc.) are described below. |
| 2.01.00 | **CODES AND STANDARDS** |
| 2.01.01 | The design, manufacture, testing and performance of the various components of the Rotary Screw type Air Compressors shall comply with the requirements of relevant codes ( IS-5456, IS-10431 [part -1], ASME PTC-9, IS-6206, IS-5727 and CAGI). |
| 2.01.02 | Other International Standards like American/BS/DIN etc. equivalent or superior to above mentioned standards are acceptable. Where IS specification is not available, the equipment shall conform to one such International Standard, which shall be indicated in the proposal. |
| 2.01.03 | The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards. |
| 2.02.00 | **DESIGN AND CONSTRUCTION** |
| 2.02.01 | The compressor shall be oil free multistage, horizontal, water cooled, rotary screw type, heavy duty, rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions. |
| 2.02.02 | The rotor and shaft shall be of single piece construction, made of forged steel (AISI C1141 or equivalent). The stator (casing) shall be of Cast-Iron (IS-210 grade) Construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration. |
| 2.02.03 | The seal rings and retainers shall be of stainless steel construction and be free for radial self adjustment along the rotor shafts. |
| 2.02.04 | Bearings shall be high precision antifriction type IS- 25 Grade 84). The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement. |
| 2.02.05 | Lubrication system shall be as per manufacturer standard practices |
| 2.03.00 | **Gear Box** |
| 2.03.01 | Gears shall have a rating of AGMA-12 or equivalent. Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving the pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position. |

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| **3.00.00** | **PERFORMANCE REQUIREMENT** |
| 3.01.00 | Air Compressors (screw /Centrifugal type) shall be designed for continuous operation with high efficiency to satisfy the performance requirement as specified in the Data Specification Sheet. |
| 3.02.00 | The power rating of the driver shall be selected such that a minimum margin of **10%** is available over the power required to deliver rated capacity against rated pressure. |
| 3.03.00 | As more than one compressor with drive is specified, satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, keeping noise level within permissible limits for a number of compressors working simultaneously in the same room. |
| 3.04.00 | Compressor frame shall have minimum 10% extra capacity. Compressor shall have 25% minimum turndown capability (at 45 deg C & 75% RH). Compressor shall be provided with IGV at the suction flange. |
| **4.00.00** | **INTERCOOLER, AFTERCOOLER & OIL COOLERS (FOR SCREW)** |
| 4.01.00 | Intercoolers, After coolers and Oil coolers shall be of water cooled & shell-and-tube type with water on the tube side. Intercoolers & after coolers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent. |
| 4.02.00 | Outlet temperature of air from intercooler shall be suitable to suit the equipment and outlet temperature of air from the compressor house outlet header shall be limited to 45 deg.C. However, the instruments or the pneumatic devices requires air temperature less than 45 deg.C., the same shall be achieved at the outlet header. |
| 4.03.00 | Coolers shall be provided with removable tube bundle design in accordance with design code TEMA Class C and shall be constructed with removable shell cover. |
| 4.04.00 | Oil Coolers shall be equipped with vent & drain connections on oil and water sides. Oil temperature control valve with manual override feature or bypass construction shall be provided to maintain constant temperature. Vent & drain connections for intercoolers and aftercoolers shall be provided. |
| 4.05.00 | Design pressure shall be 8 Kg/cm2 (g) or based on shut-off head of cooling water pumps. |
| 4.06.00 | The coolers shall be designed for maximum heat load and atleast 10 percent design margin shall be provided in the number of tubes. |
| 4.07.00 | Adequately sized safety valves shall be provided for both intercoolers and after coolers. |
| 4.08.00 | Each intercooler and aftercooler shall be provided with moisture separator units with suitable baffling. Moisture separator units shall be equipped with a level gauge glass with isolating cock. |
| 4.09.00 | Electrically operated automatic drain trap stations with bypass and isolating valves shall be provided for moisture separators for automatically draining of condensed moisture. The drain trap may be of full bore ball valve operated by capacitance type level switch. Manual draining facility shall also be provided in the drain trap. |
| 4.10.00 | Cooler shells, channels and covers shall be of carbon steel (SA 285 Gr C / SA 516 Gr 70 / equivalent).Tube sheet shall be of Brass or SS and the tubes shall be of Admiralty brass or Aluminium brass or Copper or SS 304. |
| 4.11.00 | For the instrument air compressors offered with "Heat of compression" type air drying plants, the after coolers shall be provided at downstream of Air Drying Plant. |

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| **5.00.00** | **AIR RECEIVERS** |
| 5.01.00 | The design pressure and temperature shall be minimum 10 Kg/cm$^2$ (g) and 50 deg.C respectively. Receivers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent. |
| 5.02.00 | Air receivers are to be provided with gasketted inspection manhole of minimum 500 mm diameter with cover plate, lifting handle, davit cap etc. |
| 5.03.00 | Receivers shall be of welded construction with minimum number of joints. Longitudinal seam in adjacent sections shall not be in same line. Welding shall be as per relevant codes. Filler material to have composition & structure as that of material welded. Welding electrodes to be approved by Employer. Electrodes to be dried before use. |
| 5.04.00 | Relief valves shall be provided to suit compressor capacity and set pressure of the same shall be atleast 10% above working pressure. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure. |
| 5.05.00 | Each receiver shall be provided with drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valves. |
| 5.06.00 | The material of construction of shell, dished ends, flanges, etc of the air receivers shall be of carbon steel as per IS:2062 or equivalent. |
| **6.00.00** | **INTAKE AIR FILTER AND SILENCER** |
| 6.01.00 | Filters with multiple elements quick removal type for easy cleaning shall be provided at suction of each air compressor and also be of heavy-duty dry type. |
| 6.02.00 | The filters shall be complete with integral silencers. Separate silencers, if specified, shall be provided. The filtering elements shall be easily removable for cleaning. |
| 6.03.00 | The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger. |
| **7.00.00** | **AIR DRYING PLANTS** |
| 7.01.00 | One number Air drying plant shall be provided for each air compressor. Drying shall be by adsorption process through a desiccant medium. |
| 7.02.00 | Air Drying (ADP) Plant may be of "Open Through type (Blower reactivated)" OR “Heat of (HOC) Compression type". |
| 7.03.00 | Regeneration of desiccant shall be achieved by "open through" or "Heat of compression" method without any air purge loss. |
| 7.04.00 | Hot unsaturated compressed air shall be used for regeneration of exhausted desiccant in case of "Heat of compression type ADP" and air from blower shall be used for regeneration after heating by electrical heater in case of "Open through type ADP". |
| 7.05.00 | Each ADP shall be provided with two adsorber towers each sized for design drying cycle of minimum 8 hours. After this period, the adsorber tower which was under drying mode shall be put under regeneration/reactivation mode while the other tower will take over the drying duty. The change of drying mode to reactivation mode or vice-versa shall be automatic with provision for manual operation also. The change over from one mode to another shall be through automatic solenoid operated valves. |
| 7.06.00 | In "Open Through" type ADP, for regeneration of desiccant, atmospheric air shall be filtered, heated through an electric heater and passed through the desiccant before exhausted to |

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|---|---|
| | atmosphere. The reactivated desiccant shall be cooled through same atmospheric air without heater in operation. |
| | In case of HOC type drier, the reactivation shall be achieved by the heat of the compressed air itself. The hot unsaturated compressed air from the outlet of last stage of compressor shall be passed through the adsorber tower. The moist air shall be cooled in dehumidifier and passed through the second adsorber for final drying. |
| | The design reactivation cycle/period of the tower shall be less than 8 hours including cooling period for desiccant for both the types of ADP. |
| 7.07.00 | Each ADP shall be provided with two (2) numbers of 100 percent capacity pre-filters and two (2) numbers of 100 percent capacity after-filters at the upstream & downstream of towers. The filtering media shall be of ceramic candle type elements designed to withstand atleast 50% of static pressure as differential pressure. The pre-filters shall be provided with automatic electrically operated drain trap arrangement with isolation and bypass valves. |
| 7.08.00 | The electric heaters (if required) (2x100% capacity for each ADP) shall be provided with thermostatic control for heater and relief valve for safety and shall be flanged type to facilitate easy replacement of element. |
| 7.09.00 | Each electric motor driven blower (2x100% capacity for each ADP) shall be provided with individual dry type filters at inlet. |
| 7.10.00 | The adsorber tower shall be designed with sufficient cross sectional area resulting low air velocity and pressure drop. Minimum 20% of desiccant depth shall be provided as free board in adsorber vessels. Adsorber vessels to be provided with suitable number of inspection/sight windows of "Persplex" for observation of adsorbent condition. Desiccant filling and removal connections shall be provided for the adsorber vessels. |
| 7.11.00 | The coolers/heat exchangers/ dehumidifiers of ADP shall be designed & constructed as per the requirements specified for “Intercoolers, After coolers & Oil coolers" above. |
| 7.12.00 | All pressure vessels such as pre-filters, after-filters, adsorber vessels, heaters, heat exchangers/de-humidifiers / coolers etc associated with ADP shall be designed in accordance with Section VIII, Division 1, of ASME Code or equivalent. The pressure vessels shall be provided with air tight gasketted manholes/handholes and relief valves. |
| 7.13.00 | Quantity of desiccant to be calculated shall take into account residual moisture content at the end of regeneration cycle. |
| 714.00 | Adsorption capacity and density to be considered for silica gel shall not be more than 10% and 550 $kg/m^3$ respectively. In case of activated alumina the same shall be 8% (max) and 900 $kg/m^3$ (max.) respectively. |
| 7.15.00 | In case of Heat of compression type, adsorbers shall be sized so that even when the compressor is operating at part load, complete regeneration shall be achieved within the cycle time and quality of air (dew point) shall be maintained throughout the design cycle period. |
| 7.16.00 | Complete ADP equipment shall preferably be mounted on a skid. |
| 7.17.00 | Required sample connections in piping be provided for sampling of air at desired locations. |
| 78.18.00 | Non-lubricated two way / three way / four way valves ball valves with pneumatic actuators be provided. |
| 7.19.00 | The material of Construction for various components of ADP shall be as as per manufacturer’s proven standard. |

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| 7.20.00 | HOC dryers of single rotating drum type design using packed dessicant with in-built regeneration and adsorption compartments are also acceptable in place of specified twin-tower type dryers, if the design ensures specified performance guarantee. In case, the Contractor offers such a type, the same shall be of proven design and shall meet the conditions stipulated under **"proven-ness criteria" in relevant sub-section of Part-A, of Technical Specification. The control & instrumentation requirements specified is applicable for such design also.** |
| **8.00.00** | **INTERCONNECTING PIPING, FITTING AND VALVES** |
| | The interconnecting piping & valves within compressor house for compressed air & cooling water etc shall be designed in line with the specification furnished in subsection titled "Low Pressure Piping" of Part-B of this Technical Specification. |
| **9.00.00** | **CONTROL PHILOSPHY** |
| **9.01.00** | **GENERAL** |
| 9.01.01 | The minimum requirements are specified herein and the same shall be elaborated by contractor. The Contractor shall include controls & instrumentation to facilitate safe, reliable and efficient operation for the system. The controls, protection, interlock and instrumentation system offered by the contractor shall be subjected to approval of the Employer during post award engineering stage. |
| 9.01.02 | Any of the compressor and Air drying Plant may be selectable for "shutdown", "working" or "standby" duty. |
| 9.01.03 | On tripping of working equipment, the standby equipment shall come into operation automatically in case of very low air pressure in the system. |
| 9.01.04 | All abnormal conditions used for tripping the compressor or any other equipment shall be provided with pre-trip audio-visual indication/annunciation in the control panel. |
| 9.01.05 | An electrically operated automatic valve shall be provided on cooling water supply line of each compressor & dryer (if applicable) which will automatically shut off the cooling water supply, in case any of the compressor/dryer is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of any of the compressor. |
| 9.01.06 | The following indications shall be made available in the control panels for repeating the same in main plant Control System / Panels.<br>(a) Status of each compressor<br>(b) Instrument air pressure low/high<br>(c ) Service air pressure low/high<br>(d) Dew point of instrument air<br>(e) Status of each ADP |
| 9.01.07 | Lube oil pressure and temperature in the oil circuit of compressor shall be automatically controlled. |
| 9.01.08 | Unless otherwise mentioned in the relevant electrical sub-section, automatic motor overload control system shall be included to permit continuous operation of compressors at minimum ambient air without exceeding the name plate rating of the motor. |
| **9.02.00** | **Screw Compressor** |
| 9.02.01 | Each compressor shall be in the control panel to operate either in Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) mode in case of Screw and unload/modulate/energy optimization (Auto Dual Mode) in case of centrifugal |

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| 9.02.02 | In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall operate the load-unload circuit at a predetermined set pressure, throttle the inlet valve and open the blow off valve. The compressor shall run in unloaded condition. When system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow -off valve. | | |
| 9.02.03 | In "Stand-by" mode the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor should start in unloaded condition and the compressor shall be fully loaded. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period (set by a timer). The compressor may be loaded to full load in case of drop in system pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time. | | |
| 9.02.04 | The control system shall provide warning to the operator that a hot-start condition exists for the motor driver and adequate cool-down period has not occurred after the motor was shut down. | | |
| 9.02.05 | The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/system each compressor:- | | |
| | (a) | "Air temperature high" at inlet to last stage | Alarm & trip |
| | (b) | "Low lube oil pressure" | Alarm & trip |
| | (c) | "High Lube oil supply temperature" | Alarm & trip |
| | (d) | "High oil filter differential pressure" | Alarm |
| | (e) | "Low lube oil level in lube oil sump" | Alarm |
| | (f) | "High inlet air filter differential pressure" | Alarm & trip |
| | (g) | "Low cooling water flow to air compressor" | Alarm |
| **9.03.00** | **Air Drying Plant** | | |
| 9.03.01 | Sequential operation of the adsorber towers & air compressors shall be controlled automatically with a provision for manual take over. | | |
| 9.03.02 | Change over of tower from drying mode to regeneration mode shall happen automatically if the dew point is high at the outlet of ADP sensed by the dew point (using aluminium oxide probe) meter/sensor. Automatic operation during regeneration, starting and stopping of blowers, starting and stopping of heaters, etc shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps. | | |
| 9.02.03 | The control system shall provide the (as minimum) alarms, "High Reactivation air temperature", "Low Reactivation air temperature", "Low cooling water flow", "Low air pressure at the outlet of ADP" and "High dew point at the outlet of ADP". Adequate number of temperature elements etc. shall be provided for measurement and monitoring of the same. | | |
| 9.02.04 | For rotary drum type Air drying plant, control philosophy as per manufacture’s standard and proven practice is also acceptable. | | |

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| **10.00.00** | **PAINTING**<br>All the equipments shall be protected against external corrosion by providing suitable painting.<br>The surface of SS, galvanized steel, Gun metal, Brass, Bronze and non-metallic components shall not be applied with any painting.<br>The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc as per standard procedure. |

# SUB-SECTION-I-**M4**

# FIRE DETECTION & PROTECTION SYSTEM

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| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

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**FIRE PROTECTION AND DETECTION SYSTEM**

**1.00.00 GENERAL DESCRIPTION**

1.01.00 A comprehensive Fire Detection and Protection System covering all the areas of the power plant including Employer's facilities/ system /buildings (if applicable) is included in the scope of the Contract.

1.02.00 The complete Fire Detection and Protection Systems shall be as per the guidelines/ codes/ standards / rules of TAC/ NFPA / IS: 3034 / OISD etc. and all the systems, equipments and installation shall be got approved from TAC accredited professional(s)-India.

**2.00.00 HYDRANT SYSTEM**

Hydrant system shall consist of piping, hydrant valves, landing valve, water monitors, hoses, branch pipes, nozzle, hose boxes, etc.

2.01.00 **Areas to be Covered**

Complete FGD area, ZLD area (as provided) and other auxiliary buildings / areas under the scope of the Bidder.

**3.00.00 HVW AND MVW SPRAY SYSTEM**

3.01.00 **General**

It shall consist of: Spray pumps, pressurization arrangements, water mains network, deluge valves, alarm valves, flow switches, isolation valves, Y-type strainers, spray nozzles/projectors, spray nozzles piping network, detection system, instrumentation, local control panels, cables etc.

3.02.00 **Areas to be covered by HVW Spray System**

i) All transformers For FGD and ZLD (as provided) System having oil capacity above 2000Ltrs & located with-in plant boundary.

3.03.00 **Areas to be covered under MVW Spray System**

i) All cable galleries/ cable vault/ cable spreader room in Bidder scope of work under FGD and ZLD (as provided) System.

**4.00.00 FIRE EXTINGUISHERS AND FIRE STATION EQUIPMENTS**

4.01.00 **Fire Extinguishers**

As indicated in Bidder's Scope, Part-A.

**5.00.00 FIRE DETECTION, ALARM AND CONTROL SYSTEM**

5.01.00 **Codes and Standards**

a. The design, manufacture, testing, performance, etc. of the various components of the analog addressable Fire Detection and Alarm System shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

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b. Unless otherwise specified, the Fire Detection and Alarm System and the components shall conform to the latest applicable Indian or IEC Standards. Equipment complying with any other authoritative National Standards such as British, USA, VDE, etc. will also be considered, provided the parameters specified are equivalent or better than the corresponding IS.

c. The Contractor shall be solely responsible for obtaining the required approval and clearance for the different components and systems of the Fire Detection and Alarm System from the following authorities, as applicable:

i. Department of Atomic Energy (Certification of safety from Radioactivity).

ii. Central Building Research Institute, Roorkee.

iii. Central Mining Research Station, Dhanbad.

iv. Local Fire Authorities.

d. The equipment and the system shall be of types approved by any of the following bodies, as applicable:

1. Loss Prevention Council, (LPC), U.K.
2. National Fire Protection Association, (NFPA), USA
3. Under-writers laboratories, (UL), USA
4. Factory mutual(FM)

5.02.00 **Areas to be covered under Fire detection and alarm System**

a) **Multisensor type detection system (Above and below the false ceiling or below the false flooring as the case may be)**

i) All switchgear / MCC/battery rooms of FGD and ZLD (as provided) control room building, various auxiliary buildings (if applicable), etc.

ii) Cable galleries of FGD and ZLD (as provided) control room building protected by MVW spray system. Further, multisensory detectors shall also be provided inside all cubicles/panels of control room, control equipment room and UPS / Battery charger areas.

iii) Above and Below false ceiling areas of all air-conditioned rooms of FGD and ZLD (as provided) control room building, various control rooms of auxiliaries as defined in Sl. No. (i) above and return air ducts of inert gas protected areas.

b) **Linear heat sensing cable detection system**

Gypsum and lime conveyor of FGD system and Cable Galleries covered under MVW Spray System.

c) **Quartzoid bulb heat detection system**

Equipments protected by HVW spray system, conveyors protected by MVW spray system.

**5.03.00 General requirements for all types of Detectors**

5.03.01 Detectors shall be housed or mounted in suitable enclosure in such a way that their performance is in no way affected. Special maintenance procedures if any required for the satisfactory operation of the detectors shall be clearly stated in the bid.

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| 5.03.02 | Necessary mounting accessories shall be provided for all the detectors. |
| 5.03.03 | In case the detectors are offered with their output (on sensing a fire) in the form of an electrical contact, it shall be noted that the contact shall be 'NC' type such that under fire conditions, this contact will open to initiate the fire alarm system. |
| 5.03.04 | Detectors shall preferably be designed as plug-in units, which fit into various bases according to place and type of mounting. This would also enable interchangeability. |
| 5.03.05 | Detectors shall be provided with the necessary compression type cable terminating glands for the incoming cables of flameproof type or PVC/metallic flexible/rigid conduits. |
| 5.03.06 | Depending upon the environmental conditions in which detectors are installed, chlorinated rubber based or epoxy or equivalent paint shall be used for finishing the surface of the enclosure. |
| 5.03.07 | The coverage or the zone of protection afforded by the detector and recommended height of mounting shall be furnished by the Bidder. The bidder shall furnish the test certificate in support of this. |
| 5.03.08 | Any metal parts used for detector construction shall be inherently resistant to corrosion or shall be plated or otherwise suitably treated to afford protection against corrosion. The plating or treatment shall in no way affect the detector performance. |
| 5.03.09 | Any plastic material or any sealing compound used in the detector shall be such as it will not deform or fail under the maximum temperature to be expected. |
| 5.03.10 | No detector shall contain any moving parts subject to wear and tear and must be able to operate afresh after each alarm release, without its exchange or adjustment. |
| 5.03.11 | The detector shall be located where the largest combustion gas concentration can be expected. |
| 5.03.12 | Adequate compensation and considerations shall be made for effects for wind velocities such as air-conditioning system and exhaust fans where dilution of particles of combustion is greater. |
| 5.03.13 | The exact location of detectors shall be coordinated with other services like air-conditioning grills, light fittings, cable trays etc. to provide aesthetically pleasing appearance. The return air paths of air-conditioning shall be avoided for detector location. |
| 5.03.14 | The detectors shall not be affected by temperature, humidity; air flow or by drift failures and shall not give any false alarm due to above. |
| 5.03.15 | The detectors shall not be sensitive to vibrations. Any special mounting arrangements required to counteract vibration shall be included in the contractor scope. |
| 5.03.16 | The quantity of multi- sensor detectors in each zone shall be based on the coverage factor of 25-sq. meter per detector. However the actual quantity of detectors required, taking into consideration obstructions due to floor beams, ventilation, doors, windows etc., shall be worked out and supplied (based on the actual layout) and installed by the contractor. |
| 5.03.17 | The detectors shall not give false alarm due to high humidity, temperature, and velocity of air in the surroundings and static electricity conditions. |

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5.03.18 Process actuated switch devices such as pressure switches, flow switches, level switches, etc. shall be provided with suitable individual addressable interface (local or remote) units or modules so that these devices are addressable from the panel.

5.05.00 **Linear Heat Sensor Cables**

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| Application | Detection of Stationary fire |
| Type | Digital |
| Operating voltage | 24 V DC |
| Approval | FM/UL |
| Conductor material | Steel |
| Insulation | Heat sensitive polymer |
| Outer Sheath | Black or colored PVC or flouropolymer suitable for the application environment |

**Installation features for LHSC**

1. Mounting arrangement have been indicated in tender drawing.
2. The detection zone/loop divisions of LHSC system shall match with MVW spray zones. Conveyors where LHSC shall be installed shall be divided into no. of various zones whereas conveyor for which IR detector is installed shall be considered as one zone.
3. Linear heat sensing cable detector shall run in a zigzag fashion (with an included angle of 90 deg) on each top cable tray, bottom tray and every alternate intermediate trays of each section of cable tray without undue sagging and interfering the normal operations. All supporting materials for mounting of LHSC shall be provided by the bidder.

5.06.00 **Addressable Analog Intelligent Detectors**

In addition to the features specified under the item General requirements for all types of Detectors, the Addressable Analog Intelligent Detectors shall be provided with the following features:

a) Detectors not specifically listed for sensitivity testing from the control panel are not acceptable due to the expense involved with manual testing as required by NFPA 72E.

b) The detector shall be suitable for two-wire operation and two-way communication on the intelligent analog signaling circuit.

c) The detector shall display a steady LED when in the Alarm State. The LED shall flash when in stand by or normal mode.

d) Each detector in a loop shall have short circuit isolator suitable for style-7 wiring as per NFPA-72.

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e) Address and sensitivity assignments shall be set preferably electronically. However, dip switches / rotary switches for the same are acceptable. The detectors shall be assigned a sensitivity level based on environment, time of day or any programmable function as required by the system user, and shall respond at that level whether in the “on line” or “default” mode.

f) The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system.

g) The detectors furnished shall be listed for use in environments as covered by Factory Mutual and UL and shall be installed according to the requirements of NFPA 72E for open area coverage.

5.07.00 **Multi sensor Detectors**

5.07.01 Multi sensor detectors shall incorporate a heat detection element and a photoelectric detection element. Both the elements shall be incorporated in a single unit. Both the elements shall be operative at all times and the fire signal shall be available from any or both elements combined together.

5.07.02 The detectors shall be sensitive to very low smoke densities of the order of say 0.05 $g/m^3$. Also it shall be possible to adjust this sensitivity on a step less basis over a range so that the optimum sensitivity could be selected at site to suit the conditions of installations. The coverage area of the smoke detection under standard NFPA test conditions shall not be less than 80-90$m^2$.

5.07.03 The detectors shall be complete with a mounting base that includes a terminal box into which the detector can be plugged in. Terminals for looping of the cables shall be provided.

5.07.04 All detectors shall be provided with built-in response and indicating lamps which shall give local visual indication, when it has operated in dense smoke conditions. The failure of lamp shall not prevent the function of detector.

5.07.05 In areas such as false ceiling where detectors themselves are not easily accessible, the remote response indicators outside the enclosed areas shall be provided to indicate the fire condition.

5.07.06 It shall be possible to replace any type of detector head by a different type detector without requiring change in cabling/panel wiring and condition of the zone, originally covered by the detector.

5.08.00 **System Configuration**

5.08.01 The Addressable Fire Alarm panel shall be able to communicate with repeater annunciation panel located at different places. The detectors or other devices of any other unit/area shall be addressable only from the respective Addressable Fire Alarm Panel, so that each of the Addressable Fire Alarm Panel is under the control of designated operating personnel at that location.

5.08.02 At least one spare loop shall be provided in each of the addressable type fire alarm panel located in FGD and ZLD (as provided) control equipment room with complete loop card and all other accessories so that Employer can expand the system in future. Further, at least 10% of loop capacity be left free in each of the connected loop in all the panels, so that, additional devices may be connected to the system in any of the loop by Employer in future.

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| 5.08.03 | FGD and ZLD (as provided) Fire alarm system shall be provided with necessary interface hardware and software for communicating fire alarms from this fire alarm panel to the main plant fire alarm control panel through potential free contacts. |
| 5.09.00 | **Analog Addressable Fire Detection and Alarm System** |
| 5.09.01 | General Requirements |
| 5.09.02 | This specification in general covers the functional requirements, and general design aspects of Microprocessor based, Analog Addressable Fire Detection Alarm / Annunciation and Control System. |
| 5.09.03 | The following description intends to describe only the brief hardware and functional requirements, scope of hardware requirements etc. but the actual configuration of the system shall be in line with the prevalent normal practices in the industry and shall conform to latest product range of selected manufacturer.<br><br>The fire detection and control system offered shall be complete in all respects for the safe and reliable operation of the entire system. Any additional hardware/software than those mentioned herein required to make the system complete shall be included in the scope of the Bidder. |
| 5.09.04 | All the system and its equipment specifically detectors, interface modules, panels, power supply, battery chargers etc. shall be furnished from a single source and the same shall be new and latest state of the art products of manufacturer engaged in the manufacture of Integrated Microprocessor based Analog Addressable Fire Detection and Alarm System. |
| 5.09.05 | All equipments such as detectors, panels etc shall be approved and listed by UL/FM/LPCB/VDS. |
| 5.09.06 | All types of smoke detectors shall be of analogue addressable type. Conventional detectors with interface modules are not acceptable. Each zone of LHSC detector and each IR detector shall be provided with interface module. |
| 5.09.07 | All the fire detection systems, process actuated switch devices such as pressure/flow/temperature switches and relays of control functions shall be hooked up with the analogue addressable fire detection and alarm system. Required addressable interface units shall be provided for various switch devices by the bidder to make them addressable. |
| 5.09.08 | The wiring shall be of class-A as per NFPA-72. |
| 5.09.09 | Bidder shall provide isolators at the start & end of the loop. |
| 5.09.10 | The complete system shall include, but not be limited to the following :<br><br>a) Master system CPU.<br><br>b) Analog Addressable Fire Detection and Alarm System panels including alarm modules, system supervisory control modules, auxiliary output control modules etc.<br><br>c) Power supplies, batteries and battery chargers.<br><br>d) Analog addressable type smoke detectors. |

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e) Non addressable type conventional detectors (Linear heat sensing cable detector/ infra red type heat detector) and switching devices each with its own addressable interface modules.

f) Software and hardware as required for complete operation of the system.

g) Complete Wiring/cabling including its conduits/trays/fixtures etc.

i) The fire alarm control panel shall function as a communication interface between central processing unit and sensors. This panel shall have facility to process the input signal and to control all the input data received from initiating and indicating devices.

j) Fire alarm control panel shall have filters to ignore false alarm and increase sensitivity to real fire from sensors. The sensitivity of each detector should be automatically raised if detectors are gradually polluted due to dust and dirt entering inside the detector. If detectors are more polluted the control panel shall give a warning. The trouble report shall indicate the location of device requiring service.

k) Fire alarm control panel shall have printer to print out the alarm/ trouble occurrences.

l) The CPU shall serve as the systems central processor. Software shall be designed especially for fire alarm annunciation system applications and shall monitor status of processing alarms according to priorities, controlling/processing communications and synchronizing all system activities.

n) The system shall be able to recognize and indicate an alarm condition in a degrade mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels.

o) All devices shall be individually identifiable for its type, its zone location, alarm set value, alarm and trouble indication by an unique alpha numerical label.

p) The software logic modules and system database shall be programmable using a MS - Windows compatible program (latest version) on PC at site and required hardware shall be included in scope of supply. The system software programme shall be password protected and shall include full upload and download capability and during program upload or download through the PC, the capability of alarm reporting shall be retained. The software shall be downloaded to a PC for editing. The software shall enable Employer to add the spare loop provided in the fire alarm panels or addition of additional devices/detectors in any of the fire alarm panel.

q) The system shall support the use of Color Graphic display terminal for the display of information in an appropriate format.

r) The system shall include software for system data base, historical event log, logic, and operating system. The system shall require no manual input to initialise in the event of a complete power down condition. It shall return to an on line state as an operating system performing all programmed functions upon power restoration.

s) Activation of any fire alarm initiating device shall display (LCD alpha numeric display) message in describing the device originating the alarm condition at the Central monitoring station, at alarm panel, simultaneously at the repeater annunciation panel and shall initiate the associated protection systems & other related control functions. Similarly activation of any supervisory circuit, (supervised

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valve closure, air pressure abnormal, fire pump trouble, water pressure low, etc.) or receipt of trouble report (primary power loss, open or grounded initiating or signaling circuit wiring, battery disconnect etc) shall display at the fire alarm control panel the origin of supervisory condition or origin of trouble condition as the case may be. It shall also record the occurrence of the event, the time of occurrence and the device initiating the same.

t) System configuration shall be menu driven and capable of being operated by, a person with no previous computer programming experience.

5.10.00 **System Functional Requirements**

5.10.01 The fire alarm panel shall evaluate the signals received from the detectors and shall handle the following functions:

1. System self monitoring and fault signaling.
2. Transmission of alarm and fault signals to the respective fire alarm panels and as well as in the repeater panel in fire station. Further, the panel shall activate a hooter/sounds in each of the area locally provided with fire/smoke detection system. Further, the system shall enable operation of spray system from the panel through monitoring station when the system operation is selected under remote, manual mode.
3. Initiate control functions like stoppage of conveyor, closure of fire doors, shutdown of draft fans, air-conditioning and ventilation plant/ equipment, opening smoke extraction vents, switching on smoke extraction equipment, emergency lighting etc.
4. Triggering stationary extinguishing systems such as clean agent system.
5. Supervising of unauthorised removal of a detector head from its base and giving a fault alarm on the control panel.
6. Supervising and monitoring the detection cabling, to indicate fault conditions in case of open/short circuit in the wiring.
7. Supervising by a separate annunciation window, changeover from mains supply to battery supply. “Mains On” indication shall be continuously on, as long as the main supply is available.
8. Facilitating simulation of fire conditions to enable the testing of circuits (without creating actual fire) under the test mode from the fire Alarm panel.
9. The control unit shall contain all the systems main switches lamps and fuses. Switches and lamps shall be easily identified even in closed casings.
10. All the circuits from the detectors to the panels and the circuits from panels to the actuating/operating devices of the respective extinguishing system shall be of closed loop type and shall be supervised for open-circuiting and short-circuiting of cables. The cable fault shall be audio-visually annunciated on the panels. Separate hooters with different tones shall be provided for ‘fault’ alarms and ‘fire’ alarms.
11. Actuate solenoid valve in spray system in case of fire from respective fire alarm panel. For achieving this if any additional hardware is required like relays, power supply and cables, the same may be provided.

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| 5.10.02 | **Analog Addressable Fire Detection and Alarm System shall also meet the following functional requirements:**<br><br>i. Each of the system shall support analog addressable detectors of all types, non-addressable type detectors/devices along with its addressable interface units/modules, Video display units etc.<br><br>ii. Each of the devices and/or detectors shall be individually, uniquely and continuously addressable by the panel to which it is connected.<br><br>iii. Detectors shall be interrogated for sensitivity settings from the control panel, logged for sensitivity changes indicating the requirement for cleaning and tested by a single technician using the field test routine. Sensitivity of each of the detectors made available in the panel shall be adjustable from the panel.<br><br>iv. The system shall be capable of self-adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction to prevent false indications or failure to alarm in the actual fire conditions. The system shall annunciate a trouble condition when any analog addressable smoke detector reaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarm.<br><br>v. Continuous supervision/monitoring of all the circuits and its components shall be made available from the panel for open, short circuits and grounding.<br><br>vi. The system shall be able to recognize and indicate and alarm condition in a degraded mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels.<br><br>vii. The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a PC for program editing. The software shall eligible employer to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel.<br><br>viii. The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format.<br><br>ix. The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state performing all programmed functions upon power restoration.<br><br>x. Software logic modules and system database shall be programmable using a windows compatible program on PC. It shall be possible to program or edit the system database off site after down loading from the panel.<br><br>xi. All detectors shall incorporate internal automatic temperature compensation to overcome the effects of either high or low ambient temperatures in the installed environment on the detector sensitivity. The detectors shall be tested at a specified frequency by raising the detector sensitivity level to the alarm threshold, to check the operation of the detector without system alarming |

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automatically by the control panel.

xii. In an alarm or trouble condition the following shall occur on the monitoring station:

1. Sound an audible.
2. Write details of the actuation to a system log file on the PC.
3. Print the details of the actuation to the system printer.
4. Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.

xiii. System configuration shall be menu driven and capable of being operated by a person with no previous computer programming experience.

5.11.00 **Panel Display Requirements.**

System display shall consist of minimum 80 character back lighted alphanumeric LCD display readable at any angle. Thirty-two character customer defined custom messages shall describe the location of the active device. In addition to the above, the following features shall be available.

a. The system shall be capable of programming to allow troubles occurred and restored in the system to be automatically removed from the display queue, eliminating the necessity for individual acknowledging of these events. This feature shall not affect the historical logging of events as programmed.

b. As a minimum an LED display for “Alarm”, “Audible Silenced”, “Supervisory”, “Trouble”, “Security”, “Power On”, And “Partial System Disabled”.

c. Touch activated membrane switches for “Alarm Acknowledge”, “Audible Silence”, “Supervisory Acknowledge”, “Security Acknowledge”, “Reset”, “Display Hold”, And “Display Next”.

d. All membrane switches shall be tactile with audible feedback when pressed.

5.12.00 **System Software Requirements**

i) The software shall control the operation, function and display of the graphic system and provide for automatic boot up and run from the hard disk drive of the computer.

ii) All project specifics actuating device programming shall be capable of being carried out on site via password access.

iii) The system shall monitor all alarm, supervisory; trouble and security conditions detected by the fire alarm control panel and provide separate disk based files, for each condition. These logs may be enabled, disabled, or cleared with password access.

This log information is not to be lost upon power failure or fire alarm control panel reset. A utility file shall be provided to sort the log data by date or by device and display this information either on the screen or the system printer.

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iv) Selective memory storage up to 800 events, shall be stored in flash memory and displayed, printed or downloaded by classification for selective event reports.

a. Software shall allow selection of events to be logged, including; inputs as alarms, troubles, supervisors, securities, status changes and device verification; out puts, as audible control and output activation; action, as reset, set sensitivity, arm/disarm, override, password, set time and acknowledge.

b. Audible and visual indications shall be generated when memory is 80% and 90% full to allow downloading of data. The system shall be programmable circular logging, assuring that at least the last 400 events will always be stored in non-volatile memory.

v) Software has driven logic for adjusting the alarm threshold windows on detectors to compensate for accumulating contamination and keep detector response sensitivity constant. The software shall compensate for either over-sensitized or desensitized units, raising a system flag when a detector approaches the allowable limits of adjustment, indicating a requirement for cleaning.

a. Values shall be stored in non-volatile memory allowing activation of all tracking functions within 90 sec of system initiation from a "cold boot". During the boot sequence, alarms from detectors programmed with the feature shall be suppressed.

When the full data history is active all devices shall be checked and any active alarms displayed.

b. The control panel shall place each detector in the system in an alarm condition, transparent to the system user, every twenty-four hours as a dynamic check of the accuracy of the alarm threshold setting. Upon reception of the alarm report, the system detector shall be restored to its pretest state.

c. The system shall be capable of monitoring the stage of detectors and displaying a message when a detector is approaching the limits of adjustment as a result of contaminates. A second message shall be displayed when the detector reaches the limits of adjustment due to these contaminate.

d. The system shall be capable of recognizing that a detector has been cleaned, initiating a series of tests to determine if the cleaning was successful and display a detector cleaned message, readjusting that detectors normal sensitivity setting reference.

vi) When an alarm or trouble is registered at the fire alarm control panel the graphics system shall display the first screen image for the first actuated device. The system shall be capable of zooming in for further information if required. At all times when in the alarm or trouble mode the fire control panel status i.e. number of current alarms and or troubles is to be displayed on the graphics screen.

5.13.00 **Power Supply for Fire Alarm Panels & Repeater Alarm Panel**

5.13.01 One set of 24V DC redundant power supply system comprising of 2 x 100% chargers and 1 x 100% batteries shall be provided for fire alarm panel and repeater alarm panel. The

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batteries for fire alarm system shall be sealed maintenance free lead acid type. The battery backup for each fire alarm panel and repeater alarm panel shall be 24 hours and 30 minutes (in alarm conditions). At least 25% of the devices shall be considered to be active in alarm conditions. Each of the redundant chargers shall be sized to meet connected load requirements and keep the connected batteries full charged (Float Mode). Furthermore, the charger shall be sized to enable the boost charge of a fully discharged battery in 10 hours while feeding the load.

5.13.02 The batteries shall be sized as per relevant IEEE standard. For battery sizing calculation, an aging factor of 0.8, a temperature correction factor (based on temperature of 4 deg. C), voltage drop of 2V in cables. Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering.

5.13.03 The battery chargers and batteries shall be placed at a suitable location inside the fire alarm panel with partitions.

5.13.04 The detailed specification related to power supply system of fire detection & protection system shall be as specified in other sections of the technical specification.

5.14.00 **Control & Instrumentation requirements**

5.14.01 Not Used.

5.14.02 Not Used.

5.14.03 The specification related to Basic design criteria, Measuring Instruments, Process connection & piping, Control panels, Type test requirements etc shall be as specified in other sections of the technical specification.

5.15.00 **Cabling for fire alarm system**

All instrumentation cables twisted & shielded, FRLS PVC insulated and sheathed data highway / fibre optical cables, short term fire proof cables including prefabricated cables (with plug-in connectors) etc shall be provided by Contractor.

The contractor shall follow the cable philosophy as below:

| Application | | Type of cable |
|---|---|---|
| **From** | **To** | |
| PLC cabinets | PC, Printers etc. | As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is>300 M & coaxial cable if length<300 M |
| Detectors (including detectors mounted inside panels) /Any loop device | Detector (including detectors mounted inside panels) / Isolator/ Interface unit | Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below. |
| Detectors (including detectors mounted inside panels) / Isolator / Interface Unit | JB | Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below. |

| | | |
|---|---|---|
| JB | Fire alarm Panel | Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below. |

**Notes:**

1. 10% spare pair shall be provided for all cables having more than four pairs.
2. Type "S" cable shall be multicore control cable having overall shielding & specification similar to instrumentation cable except insulation thickness and voltage grade which shall be 1100 V. Type "S" cable shall also satisfy requirements of Article 760 of NFPA 70.
3. Over and above, contractor may note that short term fire proof cables shall be provided for coal handling plant and inert gas protected areas. Short term fire proof cables shall be Mineral insulated copper conductor and copper sheathed type satisfying requirements of Fire resistance, safety in the industrial application areas mentioned in the specification and also, shall be approved by UL standards and certified by LPCB. The contractor shall provide all the cables so as to complete the system
4. Cable size of 2 core 1.5 sq.mm shall be used for loop wiring in-case of both control cable and short term fire proof cable.
5. Cable size of 2 core 2.5 sq.mm shall be used to provide power supply to various devices in the loop in-case of both control cable and short term fire proof cable.
6. The detailed specification of instrumentation cables and optical fiber cable shall be as specified in other sections of the technical specification.
7. Detector cables outside the building shall be corrugated steel taped armoured laid through cable trays wherever available and for rest of the areas, cable shall be buried at 600 mm depth with sand filling and brick covering at the top.
8. Detector cable within the building shall be either unarmoured & laid through galvanized iron (GI) conduits or armoured cables, as per the standard and proven practice of the manufacturer.

5.16.00 **Detection System for Conveyors**

i) **Linear Heat Sensor Cables:**

a) The LHS cable detector for each conveyor to be provided for both forward and return conveyors and shall be mounted as per the standard practice of the manufacturer/ supplier. Suspension of LHSC through flexible chains is a preferred arrangement. Further, LHS cable shall also be provided for return side of conveyors inside the bunker house.

b) The detection zone/loop divisions of LHSC system shall match with the MVW spray system.

c) Upon detection of fire either by QB detector or LHSC detector, the spray system shall be initiated. It shall also initiate spray system for the two adjacent zones after a time delay settable at site.

d) The LHSC detector shall be provided with suitable interface unit, which shall generate/ make the signal compatible with fire alarm panel.

(e.) Type: Digital, Operating Voltage: 24V DC, Conductor Material: Steel, Approval: FM/UL

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| 5.17.00 | **Detection System of Cable Galleries** |
| | i) In cable galleries, MVW spray system shall be actuated either by detection of fire by Linear Heat sensing cable detectors or by fire signal from Multisensor detection system. Apart from the automatic operation of spray system in the detected zone, the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously. |
| | ii) LHSC detector shall run in a zig-zag fashion (with an included angle of minimum $90^{o}$ atleast) in each of the top tray, bottom tray and in every alternate trays. The mounting arrangement of LHSC detector shall be as per manufacturer's standard practice. |
| | iii) The detection zone/ loop divisions shall match with MVW spray zones. |
| 5.18.00 | **Multisensor Detection System** |
| | i) Upon detection of fire, multisensor detector shall be annunciated in the respective panels and shall activate a local hooter/sounder in the areas where fire is activated and this fire signal shall be employed to initiate the fire extinguishing system of that area such as automatic MVW spray system of cable galleries, fire extinguishing system of Control rooms/Control Equipment Rooms. |
| | ii) Cross zoning of the signal from two adjacent multisensor detectors shall be employed to initiate the fire extinguishing system of inert gas protected areas and MVW spray system of cable galleries. |
| | iii) Multisensor detector shall be provided for return air ducts of main plant, which shall consist of intake probe, detector housing, and exhaust pipe etc. The detector shall be mounted outside the duct. |
| | iv) The design coverage area for detectors (to be considered) shall not exceed 25 Sq.M. for each detector. |
| **6.00.00** | **PIPING AND VALVES** |
| 6.01.00 | **General Data for Pipes etc.** |
| | i) Mild steel as per IS:1239 (Part-I) medium grade (upto 150 NB) & as per IS:3589 Gr 410 (above 200 NB) or Equivalent for pipes normally filled with water. |
| | ii) Mild steel as per IS:1239 (Part-I) medium grade (upto 150 NB) & as per IS:3589 Gr.410 (above 200 NB) or Equivalent and galvanised as per IS:4736 for pipes normally empty and periodically charged with water and foam system application. |
| | iii) Pipe protection shall be as follows :<br>To prevent soil corrosion buried pipes / pipes in trench shall be properly lagged with corrosion protective tapes of coal tar type as per IS:15337 or AWWA C 203. The total thickness of protective tapes to be applied on buried pipes / pipes in trench shall be 4.0mm. This can be achieved by using 4.0mm thick tape in single layer or 2.0mm thick tape in double layer. |
| | iv) Pipe thickness:<br>a) For Pipe sizes upto 150 NB and above: As per IS:1239 Part-I medium grade.<br>b) For Pipe sizes 200 NB and above refer Annexure-I. |

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v) All valves shall be as per applicable IS/BS codes & approved by TAC for specific fire protection system and shall be provided with locking arrangement (with locks) in open or close condition. Further, all gate/butterfly valves of size 200 mm & above shall be provided with spur gear reduction unit.

vi) All the flanges and counter flanges shall conform to ANSI B 16.5 Cl 150.

vii) Strainer Body as per IS:2062 (tested).

viii) Pipe Fittings

1) The material shall conform to ASTM A 234 Gr WPB or ASTM A 105 or equivalent and dimensional standard conforming to ANSI B 16.11 (socket & threaded type), ANSI B 16.9 (for butt welded fittings) and ANSI B 16.5 (for flanges and flanged fittings) as the case may be. Further, galvanised malleable cast iron fittings as per IS:1879 in Cast iron fitting as per BS-1641 are also acceptable.

2) **Grooved couplings :** Vendor may also use mechanical grooved couplings type fittings in GI pipe lines for HVW / MVW spray system. All materials and products shall be either Underwriters Laboratories (UL) Listed or Factory Mutual (FM) Approved and installed in accordance with NFPA Standard 13 / equivalent Standard.

3) The fittings shall be galvanised as per IS : 4736 for galvanised pipe application. In case of branching connections from GI mains for spray piping network, socket may be welded for more than two pipe reduction instead of standard tees.

4) Fabricated fittings shall not acceptable up to pipe size to 300 NB. For sizes 350 NB and above, fittings may be fabricated as per BS:2633/BS:534.

ix) Welding of galvanised iron pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by Employer. After, welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further, the Contractor shall provide proper zinc paint at the point of welding.

**7.00.00 PAINTING**

7.01.00 All the Equipments shall be protected against external corrosion by providing suitablepainting.

7.02.00 The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.

7.04.00 **All Steel Surfaces (external) exposed to atmosphere (outdoor installation)**

(i) **Surface Preparation :** The steel surfaces to be applied with painting shall be thoroughly cleaned before painting by wire brushing, air blowing, etc.

(ii) **Painting:** One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats synthetic enamel paint, with 25 microns as thickness of each coat. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.

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7.05.00 **All Steel Surfaces (external) inside the building (indoor installation)**

(i) **Surface Preparation :** The steel surfaces to be applied with painting shall be thoroughly cleaned before painting by wire brushing, air blowing, etc.

(ii) **Painting:** One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.

7.06.00 **Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc.**

Painting of all equipments /.components of FDPS package shall be as per manufacturer's standard practice or as detailed below whichever is superior in quality.

| Environment | Paint scheme | Total DFT |
|---|---|---|
| Normal / Mild Corrosive Environment | Primer- zinc filled epoxy<br>Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red) | Min 125 microns |
| Corrosive Environment (as in coastal areas) | Primer- zinc filled epoxy<br>Intermediate – Epoxy MIO<br>Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red) | Min 200 microns |

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**ANNEXURE-I**

**PIPING THICKNESS:**

Pipes for sizes 200 NB & above shall confirm to IS: 3589 Grade 410. The final thickness shall not be less than that specified as per IS: 3589 as indicated below.

| Nominal pipe Size (mm) | Outside Diameter (mm) | Wall Thickness (mm) |
|---|---|---|
| 200 NB | 219.1 | 6.3 |
| 250 NB | 273 | 6.3 |
| 300 NB | 323.9 | 7.1 |
| 350 NB | 355.6 | 8.0 |
| 400 NB | 406.4 | 8.0 |
| 450 NB | 457 | 8.0 |
| 500 NB | 508 | 8.0 |
| 600 NB | 610 | 8.0 |

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**Annexure-II**

**Technical Data:**

| | |
|---|---|
| 1. **Hydrant Valve** | Oblique female type as per IS:5290 |
| | MOC: Body/bonnet/stop valve/valve seat/trim : SS304/SS316 |
| 2. **Water monitor** | As per IS:8442 Type-I, Size: 75mm, Nozzle dia: 38mm |
| | MOC: Water barrel/reducer/elbow: CS (seamless)/SS<br>Nozzle: Copper alloy / SS confirm in to IS:3444 |
| 3. **Water branch pipe & nozzle** | As per IS:903 / IS:2871 |
| | MOC: Branch pipe: SS316 (Gr 4 of IS:3444) (both ends)<br>Nozzle : SS316 (Gr 4 of IS:3444), Size: min 16mm & max 25mm |
| 4. **Water line Gate / Sluice Valve** | - Design Code: a) IS:14846 or BS:5150 (for valves coming inside fire water pump house)<br>b) BS:5150 (for valves at other locations)<br>- Pressure rating: PN1.6 (as per IS:14846) / PN16 (as per BS:5150)<br>-Working Pr. :12Kg/cm2 |
| | MOC: Body/bonnet/Yoke/Wedge : CI to IS:210 FG-200<br>Spindle: SS to ASTM-A-276 type 410 |
| 5. **Butterfly Valve** | Design Code: Double flanged or lugged wafer type of low leakage rate confirming to BS:EN:593/API-609/AWWA C-504<br>Pressure class: PN 16 |
| | MOC: Body & Disc : Cast Iron, Shaft : SS 410 / SS 420<br>Seat Rings : EPDM |

# SUB-SECTION-I-M5

# EQUIPMENT COOLING WATER SYSTEM

## EQUIPMENT COOLING WATER SYSTEM

1.00.00 **BRIEF DESCRIPTION OF SYSTEM**

1.01.00 The Equipment Cooling Water System shall be provided for Flue Gas Desulphurization system Auxiliaries as described.

1.02.00 The Equipment cooling water system shall be common for all the three units. The cooling system for Flue Gas Desulphurization system Auxiliaries shall be of closed circuit type with demineralised (DM) water in the primary circuit. CW blowdown water tapped from CW pump discharge header would be used in the secondary circuit for cooling the primary circuit DM water. Hence all materials of construction used in primary and secondary side of the equipment cooling water system should be suitable for the water quality. The scheme shall be as per relevant tender drawing listed elsewhere in the specification. The DM cooling water pumps shall be provided as indicated in the relevant tender drawing. However, bidder can use secondary circuit ACW water pumps as process water pumps or bidder may envisage separate booster pumps after PHE for FGD process water (as applicable) .

1.03.00 Quality of water

(a) Primary circuit - Demineralised (DM) water

(b) Secondary circuit - Condenser cooling water

1.04.00 The pH of DM water in the closed loop shall be continuously monitored and controlled at around 9.5. The control shall be achieved by dosing sodium hydroxide in DM water overhead tank. The dosing shall be done manually by operating dosing valve.

2.00.00 **SYSTEM DESIGN**

2.01.00 The ECW system design for Flue Gas Desulphurization system Auxiliaries shall be as follows:

A centralized/combined ECW system is envisaged for all FGD system auxiliaries . In the primary circuit , Demineralised cooling water (DMCW) pumps shall discharge cooling water through plate type heat exchangers (PHE) for cooling of the FGD system auxiliaries . The outlet header from plate heat exchangers shall be suitably branched off to supply cooling water to the to the individual Flue Gas Desulphurization system Auxiliaries coolers. No booster pumping system shall be provided in the primary system. Outlet from these auxiliary coolers shall be connected back into a common return header and led back to the suction of DMCW pumps to complete the closed loop primary cooling circuit.

2.02.00 The secondary circulating water system shall receive water through a tapping from CW blow down from the CW pumps discharge header. This water will be further

pressurised by a set of auxiliary cooling water booster pumps and fed through the plate type heat exchangers and the discharge secondary water from PHEs shall be used as process water for FGD system.

2.03.00 For the primary cooling circuit, an overhead tank of minimum (normal) capacity of 5 Cu.M shall be provided by the bidder. Outlet of this tank shall be connected to the closed circuit return header . The normal capacity of the tank shall be at 60% of the tank height.to serve

2.04.00 Frame of each plate type heat exchanger shall have about 25% extra capacity i.e. the frame shall be able to accommodate about 25% extra plates.

2.05.00 Self cleaning Filters

To prevent fouling on the secondary cooling waterside of the PHE, self-cleaning type filters, (2 X 100%) shall be provided by the bidder on the secondary cooling water inlet header to the PHE.

2.05.00 Make up to the closed loop primary circuit shall be taken from the DM water transfer pumps located near DM water storage tank and emergency make up from the discharge of condensate transfer pumps. The make-up would be given to overhead storage tank.

2.06.00 Required orifices shall be provided in the primary and secondary circuit of Equipment Cooling Water system for balancing of pressure.

3.00.00 **CONSTRUCTION FEATURES**

3.01.00 **Pumps and Heat (PHE) Exchangers**

3.01.01 The general design and construction features of various pumps of the Equipment Cooling Water System shall be as per the Annexure titled "**General Specification For Pumps**" enclosed with this sub-section.

3.01.02 Specific features of various pumps and plate type heat exchangers of ECW system shall be as follows :-

**A) Pumps (ECW System )**

i) Type : Horizontal Centrifugal type

ii) Casing : Axially split type.

iii) Impeller type : Closed

iv) Speed : 1500 rpm (max.)

v) Drive transmission : Direct

vi) Seal : Mechanical seal for primary water pumps and Self water/gland for secondary side

vii) Lubrication : Oil/Grease/Self liquid.

viii) Coupling : Spacer type.

ix) Drain plug, vent, priming connection, ; Required.

x) Coupling guard, lifting lugs : Required

xi) Operating range : 40% to 120% of rated flow

xii) Pump characteristic : Non-overloading type & stable

xiii) Parallel operation : Required.

xv) Material of Construction:

| | **Primary Side DM Cooling Water Pumps** | **Secondary side Auxiliary Cooling Water Pumps** |
|---|---|---|
| a) Casing | ASTM-A-351 CF8M | 2.5% Ni CI to IS 210 GR FG-260 |
| b) Impeller | ASTM-A-351 CF8M | Bronze to IS 318 Gr. I/II or SS – 316 / CF8M |
| c) Impeller Wearing Rings | SS-316 | High leaded bronze to IS-318 Gr.V / SS -316 in case of SS Impeller. |
| d) Casing wearing rings | --------As per manufacturer's Standard ----- | |
| e) Shaft | SS-316 | SS-316 |
| f) Shaft Sleeve | SS-410 | SS-410 |
| g) Gland | ---------- | 2.5% Ni CI to IS 210 GR FG-260 |
| h) Lantern Ring | SS-316 | Bronze |
| i) Gland packing | ---------- | Teflon Impregnated /Manufacturer's standard (Non-Asbestos type) |
| i) Mechanical Seal | Manufacturer's Std | ---------- |

| | | |
|---|---|---|
| j) Base plate | ---------- MS fabricated - IS:2062 ---------- | |
| k) Stuffing Box | ---------- | 2.5% Ni CI to IS 210 GR – FG-260 |
| l) All fasteners | Stainless steel | Stainless steel |

**B) Plate type Heat Exchangers - Design Parameters**

(i) Type : Plate type, single pass

(ii) Design pressure : Maximum expected pressure to which PHE may be subjected plus 5% additional margin. Maximum expected pressure shall be based on the shut-off head of pumps (either the secondary or primary side whichever is maximum) plus the suction pressure of the pumps.

**Material of Construction**

(i) Heat transfer plate : SS-AISI-316

(ii) Compression / Fixed plates : IS:2062

(iii) Movable pressure plate : IS-2062

(iv) Guide rail : IS-2062 with stainless steel cladding

(v) Support Beam/Column : IS 2062

(vi) Plate gasket : Nitrile Rubber

(vii) Nozzle : Carbon steel

(viii) Flanges : Carbon steel

(ix) Nozzle flange Gasket : 3 mm wire inserted Red Rubber.

(x) Nozzle flange Bolts/ Nuts : SA 193 B7/SA 194 2 H.

(xi) Name plate : AISI-316

(xii) Tightening Rods : IS-1367 or equivalent

**Other Features:**

(i) Double sealing arrangement should be provided at outer edge and around ports to avoid intermixing of fluids. The inter-space should be vented to atmosphere.

(ii) Plate thickness should be adequate to withstand all operating conditions but not less than 0.6 mm.

(iii) Frame of exchanger should be designed so that 25% additional plates can be added in future.

(iv) Flanges shall be per ANSI B 16.5 for equivalent.

(v) Thickness of pressure and frame plates as per ASME sec. VIII Div. I.

(vi) Minimum corrosion allowance for heat exchanger parts shall be 1.6 mm.

(vii) After pressing all the plates shall be tested by light box/vacuum/air chamber test as per manufacturers' standard practice.

(viii) The corrosion allowance for the heat exchanger plate such as pressure parts (support plates), nozzles, sliding channels and frame shall be 1.6mm (minimum).

3.02.00 **Piping, Valves /Tanks:**

Construction features of Piping, Valves and tanks shall be as per the sub-section titled "Low Pressure Piping" of this Technical specification

3.03.00 Self cleaning strainer**:**

(a) Body of filter shall conform to IS:210Gr. FG260 or ASTM-A-515 Gr. 75/IS: 2062 and internally painted with epoxy.

(b) Strainer element shall be constructed of perforated stainless steel plant linked with stainless steel (SS316) screen for fresh water and SS316L grade SS screen for sea water.

(c) The mesh size shall be selected on the basis of average clearance between the plates of the plate heat exchanger.

3.04.00 **Construction features of ECW overhead tank**

| **Sl. No.** | **Description** | | **Tech. Particulars** |
|---|---|---|---|
| I. | Quantity | : | One (1) |
| II. | Capacity | : | 5 Cu.M (Minimum.) |
| III. | Type | : | Horizontal Dished ends |
| IV. | Design Pressure | : | Atmospheric |

| | | | | |
|---|---|---|---|---|
| | V. | Design Standard | : | ASME Boiler and Pressure Vessel code Section-VIII/IS:2825 (Class 3) |
| | VI. | Material of Construction | : | Plates to IS:2062/ ASTM A36.Minimum shell thickness shall be 6mm. |
| | VII. | ACCESSORIES | | |
| | | (a) Vent, overflow and drain | : | Required (Overflow drain to be taken upto '0' M plant drain) |
| | | (b) $CO_2$ absorber for vent | : | Required |
| | | (c) Seal for overflow | : | Required |
| | | (d) Manhole & approach ladder/platform/ | : | Required |
| 3.05.00 | **Construction features of Alkali dosing tank.** | | | |
| | Quantity per Unit | | : | One (1) |
| | Useful Capacity of Each Tank | | : | Suitable for the system (Minimum 500 lt) |
| | Size (Dia. x Height) | | : | Adequate |
| | Type | | : | Vertical cylinder, dished bottom |
| | Design Pressure | | : | Atmospheric |
| | Design Standard | | : | ASME Boiler & Pressure vessles Code Section-VIII. Div.I/ IS:2825 (Class-3) |
| | Material of Construction | | : | MS Plates to IS:2062/ ASTM A36. with rubber lining of 4.5 mm thick & Minimum shell thickness shall be 6mm. OR SS plates of minimum thickness of 3 mm . |
| | Dissolving Basket | | : | AISI-316, |
| | Agitator | | : | stainless steel 316SS construction along with drive motor of suitable rating and protection class. (With Slow speed reduction gear unit) |
| | Accessories | | | |
| | (a) | Vent, overflow and Drain | : | Required |

| | | | | |
|---|---|---|---|---|
| | (b) | Sample Connection | : | Required |
| 4.00.00 | **SIZING / DESIGN CRITERIA** | | | |
| 4.01.00 | **Pumps** | | | |
| | a) | Flow | : | <u>Secondary Water pumps:</u><br><br>Design flow – less than or equal to maximum flow available indicated in Annexure-II.<br><br><u>Primary Water pumps.</u><br><br>Design flow of all Flue Gas Desulphurization system Auxiliaries coolers.. |
| | b) | Head | : | As per system, requirement +10% margin on friction head. |
| | c) | Motor rating | : | Continuous motor rating (at 50 degree C ambient) for all pumps shall be at least ten percent (10%) above the maximum power requirement at any condition of the entire characteristic curve of the pump. |
| | d) | No. of Primary side pumps | : | As indicated in Part A of the specification. |
| | e) | No. of Secondary water pumps | : | As indicated in part A of the specification |
| | f) | Re-circulation control Valves, Piping & Pressure break down orifice. | : | Required |
| | g) | Additional design requirements | : | a) To be referred in the Annexure sub-section titled "General specification for horizontal pumps" enclosed with this section. |
| 4.02.00 | **Plate Type Heat Exchangers** | | | |
| | a) | Design Secondary water Inlet temperature | : | Not less than 36 deg. C |
| | b) | Secondary water outlet | : | Temperature as achieved subject to the maximum ACW flow indicated. |
| | d) | Overall fouling factor (minimum) (f) | : | $0.8 \times 10^{-4}$ Hr $M^2$ deg C/Kcal |

e) No. of heat exchangers/ unit : As indicated in part A of the specification

f) Overall Heat transfer coefficient [U(o)]: As per manufacturer's design

g) Dirty Heat transfer Coefficient [U(d)] : [1 / (1/U(o) +f) ]

h) Heat Transfer Area (Sqm) : $\frac{\text{Total Heat Load (in Kcal/hr)}}{\text{U(d) x LMTD}}$

i) Heat transfer area of PHE shall be selected such that each Sq.M of heat transfer plate shall transfer not more than 6500 Kcal/hr.

5.00.00 **INSTRUMENTATION**

5.01.00 All instruments, such as thermowell, temperature element alongwith temperature transmitter, flow element, pressure/DP and temperature gauge/transmitters/sensors/switches, DP switch, pH analyzer, Rotameter etc. alongwith associated devices should meet the requirement as specified in relevant sub-section of this Technical Specification and shall be sufficient to meet all interlock/protection & operation requirement.

5.02.00 Minimum instrumentation required for the Equipment Cooling water system shall be as per tender P & I Diagram wherever included in the specification.

6.00.00 **CONTROL / OPERATION PHILOSOPHY**

6.02.00 The pump suction valves, re-circulation valves and discharge valves shall be motor actuated type to enable remote operation.

6.03.00 Pump suction valves shall be provided with required limit switches for interlock & control.

6.04.00 The pumps shall be designed to operate under discharge valve open and as well as in close condition.

6.05.00 Wherever more than one sump/tank is provided, Suction header shall be interconnected such a way that any of the sump/tank may be selected from the panel for operation.

6.06.00 Any of the pump shall be selectable as standby duty. Standby pump shall come into operation on tripping of working pump or inadequate pressure in the discharge header.

6.07.00 Suction and Discharge valves of pumps shall be interlocked with start/stop of respective pumps.

6.08.00 Local emergency stop provision for each pump shall be provided.

| CLAUSE NO. | EQUIPMENT COOLING WATER SYSTEM |
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|---|---|
| 6.09.00 | All the working pumps shall be interlocked with the suction level or suction pressure condition as the case may be. Pumps operation shall be interlocked with the high discharge condition so that the pump may not operate at shut-off pressure. |
| 6.10.00 | Automatic inlet valves at supply line to each of the tank/sump shall be provided so that the valves shall open and close at low-level and very high-level respectively. |
| 6.11.00 | A control valve shall be provided to maintain a constant pressure differential between the main supply and return headers of DM water. The valve will bypass flow to maintain a constant return header pressure to compensate for fluctuations in coolant flow to the process heat exchangers due to modulating control valves on the process coolers or if any cooler goes out of service in DM circuit. |
| 6.12.00 | Alarm to indicate high differential pressure across self-cleaning filter strainers, heat exchangers as the case may be. |
| 6.13.00 | Manually operating globe / regulating valves shall be provided in the water side of each of the cooler outlet for control of flow as specified in respective equipment specification. |
| 6.14.00 | Detailed Interlock & protection logic to be implemented in FGD control system shall be provided by the contractor and the same shall be as finalized during detailed engineering. |
| 7.00.00 | **PAINTING** |
| 7.01.00 | All the equipments such as pumps, tanks and plate type exchangers of this system shall be protected against external corrosion by providing suitable painting as mentioned below. For painting of valves and piping, relevant section shall be referred to. |
| 7.02.00 | The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. |
| 7.03.00 | The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot-blasting etc as per the agreed procedure. |
| 7.04.00 | For all the steel surfaces exposed to (outdoor installation) atmosphere, a coat of chlorinated rubber based zinc phosphate primer of minimum thickness DFT of 50 microns followed up with undercoat of chlorinated rubber paint of minimum DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with minimum DFT of 50 microns and topcoat consisting of two coats of chlorinated rubber paint of approved shade and color with glossy finish and DFT of 100 microns shall be provided. Total DFT of paint system shall not be less than 200 microns. |
| 7.05.00 | For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primer of minimum thickness of 50 microns followed up with undercoat of synthetic enamel paint of minimum thickness of 50 microns shall be applied. The top coat shall consist of two coats each of minimum thickness of 50 microns of synthetic enamel paint and thus total thickness shall be minimum 200 microns. |

| CLAUSE NO. | EQUIPMENT COOLING WATER SYSTEM |
|---|---|
| 7.06.00 | Internal surfaces of ECW over tank shall be painted with One coat of unmodified epoxy resin alongwith polyamide hardener and minimum two (2) coats unmodified epoxy resin alongwith Aromatic adduct hardener and total thickness of primer and paint should not be less than 400 microns. |

**Annexure-I to ECW system Specification**

## GENERAL SPECIFICATION FOR HORIZONTAL PUMPS

(1) **SCOPE**

This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

(2) **CODES AND STANDARDS**

The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

(3) **LIST OF APPLICABLE STANDARDS**

| | | |
|---|---|---|
| IS : 1520 | : | Horizontal Centrifugal Pumps for clear cold fresh water |
| IS : 5120 | : | Technical requirements of rotodynamic special purpose pumps |
| API : 610 | : | Centrifugal pumps for general refinery service. |
| IS : 5639 | : | Pumps Handling Chemicals & corrosion liquids |
| IS : 5659 | : | Pumps for process water |
| HIS | : | Hydraulic Institute Standards, USA |
| ASTM-1-165-65: | | Standards Methods for Liquid Penetration Inspection. |

In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

(4) **DESIGN REQUIREMENTS**

(a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency

of pump shall preferably be within ± 10% of the rated design flow as indicated in data sheets.

(b) The total head capacity curve shall be continuously rising from the operating point towards shut – off without any zone of instability with the highest head at shut-off condition. Shut-off head shall be more than the rated design head by 15 % or more for radial flow pump and 25 % more than the design head for mixed flow/turbine type pumps.

(c) Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

(d) Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

| **Speed** | **Antifriction Bearing** | **Sleeve Bearing** |
|---|---|---|
| 1500 rpm and below | 75.0 micron | 75.0 micron |
| 3000 rpm | 50.0 micron | 65.0 micron |

The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface.

(e) The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements.

(f) Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

(g) The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

(5) **DESIGN CONSTRUCTION**

(a) Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.

(b) Pump Casing

Pump casing shall have axially or radially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves,

piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

(c) Impeller

Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled.

The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

(d) Impeller/Casing Wearing Rings

Replaceable type wearing rings shall be provided at suitable locations of pumps as per manufacturer's standard practice. Suitable method of locking the wearing ring shall be used.

(e) Shaft

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

(f) Shaft Sleeves

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.

Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

(g) Bearings

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard

type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

(h) Stuffing Boxes

Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

(i) Mechanical Seals

Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

(j) The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

(k) Pump Shaft Motor Shaft Coupling

The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

(l) Base Plate

A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so

constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

(m) Assembly and Dismantling

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

(n) Drive Motor (Prime Mover)

Continuous Motor rating (at 50 0 C ambient) shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump. The KW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

Annexure-II

Auxiliary (Secondary) water available

| Sl.No | Project | Maximum water available (cum/hr) |
|---|---|---|
| 1 | Kudgi (3 X 800 ) MW | 600 |
| 2 | Lara (2 x 800 ) MW | 400 |
| 3 | Gadarwara (2X 800 ) MW | 360 |
| 4. | Darlipali (2 X 800 )MW | 400 |
| 5. | Mauda II (2 X 660 )MW | 300 |
| 6. | Solapur- (2 X 660 )MW | 300 |
| 7. | Tanda –II (2 X 660 MW | 300 |
| 8. | Nabinagar (3 X 660 MW) | 475 |
| 9. | Meja (2 X 660 ) MW | 300 |
| 10. | Barh-I (3 X 660 ) MW | 495 |
| 11. | Nabinagar -4 X 250 MW | 250 |

# SUB-SECTION-I-M6

# LIME STONE & GYPSUM HANDLING SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**1.0.0 INTRODUCTION**

This section of the specification provides the detailed technical requirements for the Limestone Handling System.

**2.0.0 CODES AND SPECIFICATIONS**

2.1.0 All plant, equipment, systems and works covered under this contract shall comply with the latest editions including amendments of applicable codes, standards, statutes, regulations and safety rules as on the date of submission of bid. Particular care shall be exercised in observing compliance to the rules and regulations governing the locality where the plant is to be installed. Contractor's obligations in this regard shall not be limited to only those codes and standards mentioned in this contract. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility.

2.2.0 In the event of any conflict between the applicable codes and standards and the requirements of this contract, the more stringent of the two shall govern.

2.3.0 The specific codes / standards followed for the design of the system are as below and relevant codes are also indicated against each equipment:

| | |
|---|---|
| CEMA | Conveyor Belt Manufacturing Association |
| IS:11592 - 2000 | Code of practice for selection and design of belt conveyors |
| IS:1891 - 1994 | Conveyor and elevator textile beltings spec.Part.1 General |
| IS:14386 -1996 | Belt conveyors-Traveling Tripper- Motorised for belt widths 650mm to 1600 mm- Dimensions |
| IS:8531-1986 | Specification for Pulleys for Belt conveyors |
| IS:8598 - 1987 | Specification for Idlers and idlers set for belt conveyors |
| IS 9295 - 1983 | Steel tubes for Idlers for Belt conveyors |
| ISO 5049/1 or IS 800 | Code of construction of structural works. |
| IS 16143 (Par 2& 4)/ ASTM C50// ASTM D2013 | Lime stone Sampling System |
| IS:2062 - 2006 | Steel for general structural purposes. |
| IS:1239 2004 part 1 | Spec for mild steel tubes tubular and other wrought steel |
| IS:3589 : 2001 | Steel pipes for water and sewage (168.3 to 2504mm outside diameter) |
| IS: 325 | Three Phase induction motors |
| ASHRAE :2007 | HVAC applications |
| IS 3832 : 2005 | Manual hoist / CPB |

| | |
|---|---|
| IS 3938 : 1983 | Electric hoist |
| IS 3177 : 1999 | EOT Crane |
| IS 4894 : 1987 | Specification for centrifugal fan |
| IS 7155(part 5):1990 | Code of Recommended Practice for Conveyor safety |

The extraction capacity of dust extraction system shall be based on "American Conference of Governmental Industrial Hygienists"(ACGIH).

**3.0.0 SYSTEM DESCRIPTION**

The limestone handling system comprises the following:
Unloading, Crushing and Stacking.
Reclaiming and Limestone Bunker Feeding System

3.1.0 **Unloading**, **Crushing and Bunker Feeding System**

Indian Railway rakes consisting type of wagons as specified in RDSO G-33 (Rev-1) guidelines shall transport coal to the power plant. The coal received from wagons shall be unloaded in underground RCC hopper by means of-side discharge type wagon tippler. Side discharge type wagon tipplers are to be employed for unloading IR Coal rake. Side arm chargers are envisaged for placement of wagon on the tippler table & removal of empty wagon from tippler table after tippling. Clear access shall be provided for movement of pay loaders/ bulldozers on the hopper grating of wagon tippler. Gratings over wagon tippler hopper shall be placed and designed accordingly. Apron feeder along with dribble conveyor are employed under each wagon tippler for extracting coal from wagon tippler hoppers.

Indian Railway rakes consisting of Bottom discharge wagons shall also transport coal to the power plant. The coal received from wagons shall be unloaded in underground RCC Track hopper. Paddle feeders complete with all electrical, rails, supporting structures, end stops, cable reeling drums, trailing cables, and necessary arrangement for cabling on floor of track hoppers along with accessories, shall be installed at the bottom of the Track hoppers to scoop the coal from track hoppers and feed coal on to the underground conveyors.

Limestone received through Indian railway rakes will be unloaded in one of these three side discharge wagon tipplers or track hopper.

Alternatively, Two (2) numbers Box feeders/ Bulk material receiving unit/ Truck unloading system/ Surface feeder for unloading of limestone from trucks/ self-tippling trucks/ loader shovels, This unit shall feed limestone onto the conveyor before crusher house. The complete truck unloading system must not have any underground structures/facilities.

A mechanized system shall be provided for unloading of limestone from trucks. The unloaded limestone shall be conveyed up to the limestone conveying stream before the limestone crusher.

**3.2.0 Conveying**

Limestone shall be conveyed using same conveyors as for coal before being taken to dedicated limestone crusher house.

**"**As received" limestone shall be fed on the double stream conveyors from where the same shall be conveyed upto the crushers. The crushed limestone shall be conveyed by double stream conveyors up to the limestone storage shed. From the limestone storage shed paddle feeders will extract/ reclaim crushed limestone and feed the same onto double stream conveying system up to the limestone mill bunkers.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

3.3.0 **Crushing**

In limestone crusher house, limestone from each incoming Conveyor shall pass through two (2) numbers of (dedicated) Vibrating grizzly/ screening Feeders and two (2) numbers of (dedicated) crushers respectively which shall crush limestone to (-) 20mm size or to suit limestone pulverizer and system. Each stream shall have a set of Rod gates and Rack & Pinion Gates before Vibrating grizzly Feeders to permit maintenance of equipment, hoppers and chutes in one stream without affecting the operation of other stream. Limestone sampling unit shall be provided to sample the limestone from either stream.

A passenger cum goods elevator shall be provided in limestone crusher house.

3.4.0 **Limestone Storage and Bunker feeding system**

Crushed limestone shall be stored in covered ground storage sheds using mobile trippers. The capacity of the storage shed shall be equivalent to limestone consumption for at least 7 days.

Two (2) numbers Travelling trippers shall be provided one each on a conveyors. The Travelling trippers shall operate on rails for stacking the Limestone in the stock yard area. During reclaiming operation the reclaimed Limestone shall be conveyed to the conveyor by the Paddle feeders for Conveying to Limestone Bunkers.

From Reclaim hopper, crushed Limestone of (-) 20mm size would be fed to Limestone bunkers through a series of belt conveyors, passing through various Junction Towers and ploughs/ fixed trippers.

**3.5.0 SYSTEM DESCRIPTION: GYPSUM HANDLING PLANT**

Double conveyor stream shall be provided for conveying dewatered gypsum from gypsum vacuum belt filter to over ground storage under a shed near plant boundary. The storage shed shall be sized for 7 days of gypsum production with all the units in operation. Gypsum from storage shed shall be loaded to user's trucks using front end loader/ payloader.

**4.0.0 MAJOR EQUIPMENT OF LIMESTONE HANDLING SYSTEM AND GYPSUM HANDLING SYSTEM**

Specifications for Coal Handling system equipments shall be generally followed for Lime Handling System & Gypsum handling System unless specified otherwise.

**4.1.0 BELT CONVEYOR SYSTEM**

The belt conveyor system shall confirm to the latest edition of the following standards & codes :

"Belt Conveyors for Bulk Materials" published by Conveyor Equipment Manufacturers' Association.

| | | |
|---|---|---|
| IS:7155 | : | Codes of Practice for Conveyor Safety. |
| IS:1891 (Part-I) | : | General Purpose Belting |
| IS:8598 | : | Idlers and Idler Sets for Belt Conveyors |
| IS:4009 (Part-II) | : | Conical Head Grease Nipples |
| IS:8531 | : | Pulleys for Belt Conveyors. |

IS:2062 : Hot Rolled Low, Medium and High Tensile Structural Steel

IS:4682 : Codes of Practice for Lining of Vessels and Equipment for Chemical Processes.

IS:11592 : Code of practice for selection and design of Belt Conveyors.

CAN / CASA - M422 M87 : Canadian standard association.

4.1.1 **Belting:**

The belting shall be of either synthetic fabric such as Nylon-Nylon etc. with rubber covers of adequate flexibility to give a troughing angle of 35 deg.

For all the conveyors the number of plies, cover thickness, factor of safety etc. shall be as per the recommendation of belt manufacturer, but not inferior to the figures as tabulated in data sheet. ***Longitudinal joints in the plies of synthetic fabric belts is not permitted.***

4.1.2 **Idlers**

Carrying idlers shall be provided with three equal rolls with troughing angle of 35 deg. and 2 deg. forward tilt (except in case of reversible conveyors). The diameter of the idler roll shall not be less than 152 mm for both carrying side and return side. However for impact idlers roll the steel diameter shall not be less than 139 mm and rubber thickness shall be minimum 25 mm. Roller used in idlers shall be made from ERW steel tube. Wall thickness shall be minimum 4.0 mm without any negative tolerance. The rollers shall be mounted on EN-8 or equivalent material spindles by means of ball bearings of either deep groove type or seize resistant type (SKF/Equivalent), of 30 mm size for carrying idlers and 20 mm size for return idlers. The bearings shall be adequately sealed and lubricated for life. The rolls shall be supported from fabricated steel brackets. Fixing arrangement of rollers with brackets shall be drop-in type. For adjusting the alignment of the idlers, slotted holes shall be provided in idler supporting base plates. Direction of belt travel shall be clearly marked on the brackets of carrying idlers by embossing / punching. Idler rollers shall be waterproof, dust proof and weather proof against a high velocity water jet. All idlers shall be provided with minimum double labyrinth dust seal. All the conveyors shall be provided with one self cleaning type rubber disc return idler located near the head pulley for cleaning the return belt. Transition type troughing idlers shall be used adjacent to all pulleys to permit proper support of the loaded belt near the pulleys without excessive stretch of the belt edges. The transition idlers shall be provided with preferably adjustable concentrator (end) rolls and long center rolls to suit the troughed belt contour between the last regular troughing idler and the adjacent pulleys. The transition length and the number of the transition idlers shall be selected depending upon the tensions, type and size of belt, number of plies and other necessary governing factors.

**4.1.3 Belt Cleaners**

**(i) External Belt Cleaner**

Spring loaded scraper type cleaner with modular segmented and replaceable polyurethane scrapers blades complete with main cleaner, pre-cleaner (mounted separately) along with accessories and necessary fines (reject of scrapper) chutes shall be provided for all belt conveyors, tripper head pulley (not applicable for plough type feeding arrangement) and belt feeders at discharge pulleys. The modular units shall be easily replaceable. The scraper assembly shall be easily maintainable from outside without any interference with the chute arrangement and assembly.

**(ii) Internal Belt Cleaner**

V-plough type belt cleaner made of mild steel flats and hard rubber strips with automatic wear adjustment and necessary accessories shall be furnished for cleaning internal surface of the conveyor belt.

**4.1.4 Belt Take-up Arrangement**

Automatic take-up of gravity type shall be generally provided with necessary take-up arrangements complete with bend pulleys, take-up pulley, with its supporting / sliding assembly, wire ropes with turn buckle arrangement (to adjust the level) for suspending the separate take - up weight sliding assembly close to the ground, counter weights and other accessories. Suitable guards marked up scale attached to the frame to monitor belt stretch and access/maintenance platforms with handrails all around etc. shall be provided.

**4.1.5 Pulleys**

The nominal diameter and face width of the pulleys shall be as stated in IS: 8531. The snub pulleys on each conveyor shall be located to provide a belt wrap on the drive pulleys of not less than 210 deg. The pulleys shall be made from mild steel conforming to IS:2062 (Tested Quality). However, for conveyors with in line magnetic separators, the head end pulleys shall have shell and end disc made of non-magnetic stainless steel material. Suitable stiffening shall be provided at all weld location in the shell on all pulleys. All the pulleys shall be mounted on the forged steel shafts of EN-8 or equivalent material of adequate proportion by taper lock arrangement, running in heavy duty roller bearings with proper greasing arrangement. The plummer blocks for pulleys shall be of horizontally split type construction with minimum (4) nos. bolts holding the two split halves and with min (4) nos. foundation bolts. The plummer blocks shall be dust tight with double labyrinth seals. Conical head shape nipples conforming to IS:4009, suitable drain plug and eye bolt shall be provided. Side covers of plummer blocks shall be heavy duty metallic sheets.

**4.1.6 Drive Motors**

Rating of all drive motors of conveyors shall not be less than 120% of the power required at drive motor output shaft at specified design capacity. The motor rating shall be at 50 deg Cent. Ambient. Single LT drive motors shall be used for conveyor drive ratings up to 160 KW. For conveyor drive rating beyond 160 KW, single HT drive shall be used for conveyors.

**4.1.7 Conveyor Bridges**

All overground and overhead conveyors shall be located in suitably enclosed bridge structure. Structural steel bridges of adequate width and depth (2700 mm clear head room) shall be provided complete with conveyor bottom deck plates, seal plates, walkways of chequered plates with anti-skid arrangement(s), hand rails (on both sides of each conveyor belt except where equipment (like trippers etc.) traverse over conveyor supports. Side and central walkways for double streams conveyors shall be 800mm and 1100mm wide respectively. The side walkways for single conveyors shall be 800 mm on one side and 1100mm on the other side. All conveyors shall be provided with 12 G steel seal plates throughout the length of the conveyor gallery in such a way that complete gallery bottom surface area forms a single water proof floor and no water / limestone falls down from conveyor gallery incase of cleaning / washing. The conveyors shall be provided with continuous decking plate of minimum 3 mm thickness plain steel sheet. Provision shall be kept with platforms and ladders for crossing over the conveyors at approximately every 100m intervals of route length and minimum one per conveyor.

**4.1.8 Belt Vulcanizing Machine**

Belt Vulcanizing Equipment shall be suitable for hot vulcanizing of belt splice and shall be of

easy-to-handle type. Equipment should be suitable for vulcanizing of entire splice width in single setting. Equipment should be capable of applying uniform pressure over the splice by pneumatic or hydraulic means. Heating element should be preferably of flexible type.

**4.2.0 ELECTRO HYDRAULIC THRUSTER BRAKES**

The necessary Electro Hydraulic Thruster (AC) brakes / disc brakes, totally enclosed and fail safe, shall be provided as required for various equipment's. Braking torque shall be adjustable from 0 to 100% of rated braking torque. The thruster brake shall be actuated by compression springs. The electro hydraulic thruster shall be fitted with the brake. Limit switches shall be provided for brake applied/released positions. The windings shall be provided with class-B insulation suitable for 415V ± 10% at 50 Hz ± 5% and combined variation of ± 10%. Brake lining shall be asbestos with inter woven brass wires capable of withstanding 200°C temperature.

**Clamp**

Electro-hydraulic thruster rail clamp shall be actuated by compression springs, the spring shall apply the clamping force directly on the Rail clamp mechanism once power supply is cut-off. The force transmission mechanism from spring to rail clamp faces shall be very simple with minimum linkages. Manual rail clamp shall be provided with positive locking arrangement and shall apply clamping force directly on rails. The manual rail clamp shall be of proven design.

**4.3.0 MONORAILS AND HOISTS**

4.3.1 The Monorails & Hoists shall conform to the latest edition of the following standards & codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.

| | | |
|---|---|---|
| IS:3938 | : | Specification for Electric Wire Rope Hoist |
| IS:3832 | : | Chain pulley blocks |
| IS:2429 | : | Round steel short link chain |
| IS:6216 | : | Short link chain grade 80 |
| IS:15560 | : | Points hooks with shank up to 160 Tonne - Specification |
| IS:210 | : | Cast Iron Castings |

4.3.2 For the Hoists with more than 2.0 tonne lifting capacity or more than 10.0 M lift, with the exception of hoists for GTU and bend pulleys motor operated hoist blocks for both long travel and lift shall be provided. Other hoist blocks shall be of hand operated type for both travel and lift. All monorails coming out of the buildings shall be provided with electric hoist blocks, irrespective of load and lift. Minimum 3 meter length of Cantilever from edge of building/cladding, shall be provided in monorails coming out of the building to lower the equipment to ground level clearing the building sidewalls / cladding and any other facilities beneath the floor upto ground level. Clear height shall be maintained when handling one equipment over other, in such case dismantling of any equipment shall not be permitted. The center line of monorail shall not deviate by more than 500 mm from the center of gravity of any equipment that is to be lifted.

4.3.3 The electric hoist shall be designed and constructed in accordance with the latest revision of IS:3938 and shall be suitable for duty class 2. For electric hoists, trolley movement and hoisting shall be effected by using two separate motors. Motors shall be as per technical

requirements discussed elsewhere. However the motors shall be suitable for 150 starts per hour at 40% CDF. Motor operated geared trolley shall have two (2) pairs of wheels, one pair of which shall be driven through motor. An electromechanical brake shall be provided for hoisting as well as cross travel. Brake lining shall be of asbestos

4.3.4 Wire rope shall be of pre-formed type, hemp cored, regular lay 6/36 construction with a breaking strength of 160 -175 kgf/ sq. mm. Minimum number of falls of rope shall be four (4). All running shafts and wheels shall be fitted with ball / roller bearings with a rated life not less than 20 years based on equivalent running time as per IS:3938.

4.3.5 All chain pulley blocks shall be designed to IS:3832, the operating hand chain shall conform to IS:2429 grade 30 pitched and polished and the load chain to IS:6216 grade 80. The chain pulley block shall be suitable for duty class 2. Hooks shall be as per IS: 15560 & with antifriction bearing.

4.3.6 The hoist mechanism shall consist of a grooved rope drum driven by electric motor through gears. Each end of the rope shall be anchored to the drum in such a way as the anchorage is readily available for maintenance. Each rope shall have two (2) full turns of the drum when the hook is at its lowest position and one (1) spare groove when the hook is at its highest position. The leading rope taken by the drum should not slope sideways when slack and it should not be caught between the gear wheel.

4.3.7 Inline magnetic separator shall have motorised hoist for handling / maintenance purpose. Each suspended magnet shall be provided with a dedicated motorised trolley.

**4.4.0 CHUTES, SKIRT BOARDS, FLAP GATES, ROD GATE AND RACK & PINION GATE**

**4.4.1 Chutes**

i. Direct impact of material on conveyor belt shall be avoided by providing an inclined surface at 60 degrees valley angle at the feeding point to guide the material in the direction of belt travel. Further, chute construction below flap gate shaft shall be such that there will not be any accumulation of limestone dust between chute and flap gate in that zone. Hoppers and Chutes shall be made of minimum 20 mm thick TISCRAL / SAILHARD / LSLAS07 or equivalent material. Long chutes guiding flow from considerable height shall be provided with impact plates wherever change in direction of flow takes place. Hinged inspection doors of leak proof construction shall be provided for access/ maintenance purpose at approachable heights for chutes and flap gates. All chutes should have one inspection door at every floor and for the ones in between the floors (more then 1.5 meter above the operating floor level) suitable access for trouble free maintenance shall be provided. For sealing of inspection doors labyrinth type arrangement to be provided. In addition to positive locking arrangement, mounting bolts, to tighten the door further against rubber shall also be provided. Bottom sides along with its adjacent sides shall be flanged and made from TISCRAL or equivalent material of 20 mm thickness. The non-striking surface i.e. the covers of the trough shall be of 10 mm thick mild steel and bolted to the flange provided on the trough. Further, the chute boxes not more than 1.5 m in length shall be joined through bolted flange connection to form the chute legs. Adequate care shall be taken to locate the flange joint away from floor level for easy maintenance. Complete chute work in the region of flap gates shall be fabricated from 20 thk TISCRAL or equivalent. In case of vertical chute (valley angle more than 80 degree) complete chute, work shall be of 20 mm thick TISCRAL or equivalent material.

ii. Hoods over the conveyor head pulleys shall be made of suitably stiffened minimum 4 mm M.S. Plates and shall be provided with hinged and gasketed inspection doors with suitable access to them. Further, serrated rubber seal shall also be provided at the very inlet of head chute to minimize dust nuisance.

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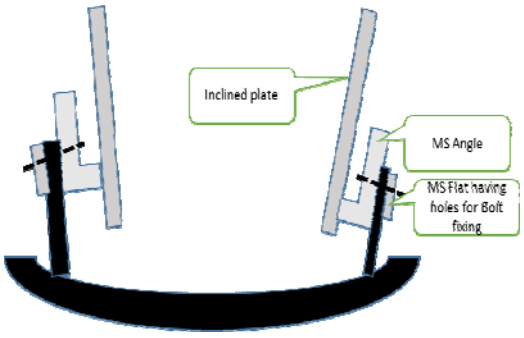
4.4. 2 **Skirt board**

Skirt board shall ensure centralised loading of conveyor belt to avoid limestone spillage. Suitable 'Skirt Plates' shall be provided for entire feeding chute and shall be extended minimum 3m ahead of front edge of chute and 500 mm beyond rear edge of chute. The width of the Skirt Boards shall be two-third the conveyor belt width. In the belts where limestone of appreciable lump size (250 mm) is being conveyed, the gap between the bottom of the skirt board and the belt shall be made to increase uniformly in the direction of belt travel. The height of the skirt boards shall be sufficient to contain the material volume as it is loaded on the belt and shall not be less than 750 mm for conveyors. The height of the skirt board for belt feeders/ reversible belt feeders (if any) shall be minimum 1000 mm. The skirt plates shall be fitted with replaceable belt piece having facility of adjusting the pressure on the belt conveyor.




4.4. 3 **Flap gate**

i. The motor operated 2 position flap gates shall be provided in transfer chutes as specified and shall be complete with electrically operated actuators. The gates shall be of robust construction and suitable for trouble free operation. The face of the flap gate shall be made out of 20 mm thick TISCRAL or equivalent material. The equipment shall be capable of being operated for at least 15 switchings per hour at rated load and thrust and shall be suitable for 10 Nos. consecutive switchings at rated load and thrust. The flap gate travel shall be in the range of 60 deg. to 70 deg. Suitable travel dependent limit switches controlling the travel of the flap gates on either direction shall be furnished. These shall be placed internal to the drive unit and shall be completely dust-proof. The limit switches shall be capable of adjustments to vary the total length of travel of the gates. Suitable thrust dependent limit switches shall be provided in the actuator, which shall trip off the actuator motor in case of excessive thrust due to jamming of the gates during its travel in either direction. The same shall also be integral to the drive unit and shall be dust proof. Approach/maintenance platforms complete with the chequered plate floor, hand rails, ladders etc. shall be provided for all flap gates. The platforms shall be extended for access to dust & debris chute inside buildings.

ii. Provision for alternative manual operation shall also be made using declutchable hand wheel of 500 mm diameter. Limit switch for safety of person operating the hand wheel shall be provided. Manual effort required to operate the flap gate shall not exceed 25 kg. All the actuators in the plant should be selected based on heaviest loading, but the rating shall not be less than 2500 kg with a lever arm of 1.0 m in any case. For standardization purposes, only one standard type of actuator for flap gates shall be provided.

iii. The material of shaft shall be EN-8 or equivalent. The diameter of the shaft shall be suitable for motor stalled condition and associated twisting. However, the diameter of the shaft shall not be less then 150 mm.

4.4.4 **Rod Gate**

Suitable manually operated rod gates shall be provided over rack and pinion gates for their easy operation and maintenance.

4.4.5 **Rack & Pinion Gate**

(i) The rack and pinion gate shall be guided properly and suitable rollers with bearings sealed for life and dust proof shall be provided. Rotary actuator operated rack and pinion gates shall be provided.

(ii) The rack and pinion gates shall be of mild steel construction with liner plate of 10 mm thick TISCRAL or equivalent material. The gates shall be operated by means of double rack and pinion. The material for rack & pinion wheel shall be cast steel and shaft shall be EN.-8. Provision for alternative manual operation (manual effort 25 kg) of motorized rack and pinion gates shall also be made. Limit switch for safety of person operating the hand wheel shall be provided.

**4.5.0 DRIVE EQUIPMENT**

**4.5.1 Gear Box**

The gearboxes shall be designed for 24 hours continuous duty. Gearboxes with cooling coils or external cooling are not acceptable. The gears used shall be helical conforming to IS:3681 (latest revision) or worm reduction units or spiral bevel speed reduction units conforming to suitable Indian Standards. The dimensions of the shaft end shall conform to IS:3688 or its latest revision. Above 40 kW drive rating, all gearboxes shall be helical or bevel helical type only. all gearboxes shall have suitable breather plugs, dipstick, drain plug etc.

**4.5.2 Flexible / Rigid Coupling**

The design of the coupling shall be such that it can take shock and misalignment without sacrificing its efficiency. Geared type flexible coupling shall be used on low speed side for all conveyors and other drive chains where gear box is provided. Other couplings in the drive chains shall be either rigid or flexible type, depending upon the requirement of equipment design.

**4.5.3 Fluid Couplings**

Fluid couplings shall be provided in all the drive machinery for belt conveyor systems and limestone crushers if the actual power requirement at motor output shaft is more than 40 kW. The fluid coupling for LT motors shall be of traction type and for HT motors, shall be of scoop tube type. Suitable electrically operated actuators shall be provided for scoop tube operation from local as well as remote. Manual operation may also be provided. Separate pump with motor or integral shaft driven oil pump shall be provided for circulating the fluid coupling oil through oil cooler. Forced cooling water supply to oil cooler shall be provided for which cooling water pumps to be provided for group of scoop couplings. **Alternatively, Air cooled type scoop coupling is also acceptable for all conveyors with HT motors for ( AHP, LHP, GHP) and crusher scoop couplings.** Suitable interlock using flow switches shall be provided in both oil as well as water lines to trip the drive motor in the event of flow in either lines falling below acceptable levels. Suitable pressure indicators and flow indicators shall be provided in the cooling water lines along with all-relevant valves, and accessories. Necessary isolation valves shall be provided in the oil / water line for

maintenance of any equipment in the line. Necessary interlock shall also be provided so that the HT motor cannot be started from remote / local unless position of scoop tube permits no load start of the motor. Tripping of downstream equipment while the system is under normal operation shall result in scoop tube re-positioning to permit no load run of the concerned HT motor. Temperature switch shall be provided in the oil circuit and shall trip the system in case of high oil temperature. The scoop tube operation must be such so to ensure draining of oil from the operating circuit by providing a double speed motor. The speed (for draining) shall be selected to match the coasting time of down stream equipment/conveyor.

**4.6.0 LIMESTONE HANDLING PLANT (LHP) BUILDINGS**

4.6.1 All LHP buildings shall have sufficient space to accommodate the entire equipment like head end, drive unit and tail end of various conveyors, chutes, control equipments, MCCs, batteries, supports for conveyor bridges, tensioning arrangements, approach/maintenance platforms with ladders, external / internal stairs, handrails, RCC floors, foundations etc. Moreover, ample space shall be provided for maintenance purposes. Outside stairs to junction towers shall be open type. However, a weather canopy shall be provided at the top.

4.6.2 Building floors shall be washed periodically with water for which necessary slope & drains shall be provided from each floor leading to minimum 4 nos down comers of minimum 273 mm OD each building. However for MCC, control buildings and pump houses, minimum 150 mm dia, 4 nos galvanized MS pipes conforming to IS: 1239 shall be provided. The system shall be designed considering water mixed with limestone. A drain pit shall be provided near each building to collect water/limestone mixture. Overflow from this pit shall be connected to nearest drain. 1 mtr x 1 mtr size dust/debris MS chutes from all the floors to ground floor shall be provided at all buildings/junction towers and limestone crusher house. The plate thickness shall not be less than 6mm. Openings in the floors of LHP buildings (i.e. JTs/CH etc.) shall be provided with curb of 100mm high to avoid water falling down to lower floors.

4.6.3 Floor at ground shall be provided in all junction towers, ground conveyors etc. Level of floor at ground shall be 500 mm above ground/grade level unless noted otherwise. For enclosed ground conveyor 750mm wide plinth protection along with drainage arrangement shall be provided along the conveyor on both sides. Suitable opening at every 50mtr interval shall be provided on either side in a staggered manner for exit / entry of personals. Necessary drains must be provided all along the floors of ground conveyor.

4.7.0 **TRAVELLING TRIPPER AND BUNKER SEALING ARRANGEMENT**

4.7.1 Mobile Trippers on bunker conveyors along with belt sealing arrangement shall be furnished and erected complete with rails, including necessary supporting structures, approach/ maintenance platforms with ladders and hand railings, trailing cables, all electricals including machine mounted local control panel & control panel on one end of Bunker. The Mobile tripper on bunker/yard conveyors shall be motor driven type. The tripper shall have provision for dropping limestone from conveyor onto both sides of tripper to the bunker/storage shed or back to the conveyor for the purpose of skipping intermediate bunkers (as applicable). The rating of tripper travel motor shall be adequate to move the tripper smoothly either in same or opposite direction to belt direction under fully loaded conditions. Adhesive weight requirement and tractive effort calculations shall be subject to approval of Employer. Coefficient of adhesion shall be considered as maximum 0.15. Minimum two drive axles shall be provided for tripper travel. Arrangement shall be provided at the starting point of the tripper to avoid folding of belt. In case of tripper running at a speed more than its rated speed due to chute jamming or other reason, conveyor shall trip and annunciation shall appear.

4.7.2 Supply of adequate length of rails to cover the runway length for the motor driven tripper shall be included. The supporting structures for the rails with necessary end stops shall also be supplied under this specification. Suitable belt hold down guide pulley shall be provided over the concave curve of belt over tripper. The travelling trippers shall be provided with fail

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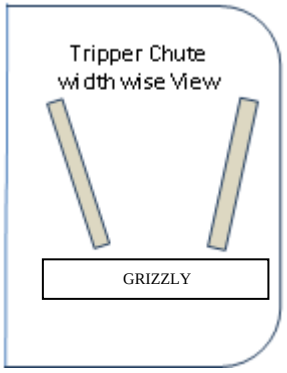
safe A.C. thruster operated brake of totally enclosed type which shall engage as soon as tripper travel motor stops. A.C. thruster operated rail clamps along with manual Rail clamps on both side of the tripper shall also be provided. Independent motorized linear actuator shall be provided to operate each flap gate of the tripper chute.

4.7.3 The sealing belt shall be of suitable grade (minimum 2 plies) with 5 mm x 5 mm covers (fire resistant) in line with other conveyor belting. The belt shall rest on 20 x 50 mm MS plates spaced at 200 mm placed 50 mm below floor level, provided over the bunker slot on tripper floor for tripper conveyor. The width of the bunker seal belt shall be at least 100 mm more than the bunker slot opening.

4.7.4 The tripper shall run on rails (90 lbs/yard) with double flanged wheels. Rails for tripper travel shall be mounted on supporting structure of respective conveyors. Suitable system having encoders for monitoring position of tripper in DDCMIS shall be provided. In addition, travel end limit switches and end stops shall also be provided. Suitable access platform of chequered plate with ladders, handrailing and walkways on both sides shall be provided for access/maintenance of equipment on tripper. In addition, crossover platform shall be provided with tripper so that operator can cross the belt through the same. 3mm deck plate continuous shall be provided below carrying idlers on the trippers.

Tripper discharge chute shall be of tapered section as shown in the sketch below.




**4.8.0 PLOUGH SYSTEM (IF APPLICABLE)**

As an alternate to travelling tripper (Alternate option applicable only for limestone mill bunkers) plough type system may be provided by the bidder. The plough type system shall consist of the following.

i. The system shall feed limestone to one bunker at a time.

ii. The plough shall be retractable type.

iii. Shall meet the capacity of the conveyor (150 TPH).

iv. The scraper/plough would normally be kept up in idle position allowing material to pass through and interfere with next lowered scraper/plough. In case material needs to be discharged scraper/plough will be lowered and fixed to that position till material fill up the bunker. The scraper/plough should be motor/cylinder/coil operated for remote operation.

v. The system must contain containment skirt boards with dust seal along the discharge area.

vi. The system shall be capable of unloading minimum 99% amount of limestone passing under it.

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vii. However the system shall be complete from operation, maintenance and safety point of view.

**4.9.0 LIMESTONE CRUSHER AND VMS**

**4.9.1 General**

Hammer mill type crusher shall be provided for sizing the input limestone to a size which shall be suited for their limestone pulverizer and system. Crusher shall be supplied complete with accessories and subsystems.

**4.9.2 Codes and standards**

The design, manufacture, inspection and testing of Limestone Crushers shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Limestone Crushers shall conform to the latest edition of applicable standards and codes. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Employer shall be final and binding.

**4.9.3 Design requirements**

i. The crusher shall be of hammer mill type and shall be designed based on following clauses and the data sheet enclosed.
ii. The crusher design should be such that the crushing action is accompanied by the minimum of attrition.
iii. Uniform crushing impact shall be assured.
iv. The crusher shall be capable of delivering the normal rated output even when handling damp limestone having maximum moisture content. No clogging or building up of material on the crushing element shall develop.
v. Temperature sensing devices shall be installed on both bearings of each of the crusher to trip the crusher incase temperature goes beyond allowable limit.
vi. Zero speed limit switch shall be provided for protection against any un-crushable material. It shall sense the speed of rotor and shall trip the rotor when actual speed falls below the design speed.
vii. Crusher shall be provided with vibration monitoring (VMS) system. Specification of VMS shall be as specified elsewhere.

**4.9.4 Construction requirement**

**i) ROTOR**

The rotor shall consist of Forged steel shaft, with integral discs or key fitted discs on shaft. Hammers shall be held by spring dowel bushes & shall be arranged around the circumference of the rotor. The number of hammers and number of rows shall be selected as per requirements. The rotor shall be balanced statically.

**ii) GRINDING WALL**

The grinding walls shall be arranged symmetrically around either side of the rotor and carried by spindles supported in bearings attached to the casing. The wall shall consist of grinding wall supports and wear resistant grinding plates/Impact plates bolted on. For product size control, distance between the grinding plates and hammer shall be adjustable.

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**iii) HAMMER**

The hammer shall be in two parts- head and arm. The hammer head shall be of wear resistant steel material. The hammer arm shall be of forged alloy steel. In the event of wear, only the hammer head shall be replaced. Arms shall be selected so that they have long life and do not require frequent replacement.

**iv) FRAME /HOUSING**

The housing shall be split type. Housing shall be fabricated from MS steel plates of weld able quality and shall be stiffened suitably. Maximum accessibility shall be provided for routine inspection and replacement of parts. For these purposes, the doors shall be of hinge connection with effective dust sealing arrangement. Hydraulically operated top cover of crushers shall be provided for quick inspection and replacement of hammers. The entire inside surface of crusher coming in contact with limestone shall be provided with abrasion resistant liners.

**v) DRIVE**

The hammer crusher will be driven through Electric motor, scoop type hydraulic coupling and gear box.

The material of construction for major components of crusher shall not be inferior to the quality and standards as mentioned in data sheet.

Design and construction features of hammer mill crushers offered by the bidder shall be similar to the crushers which are already working satisfactorily for same or higher capacity.

4.9.5 Vibration monitoring system should be offered for crushers as indicative below:

| Sl.No | Equipment | Type | No. | * No. of location per equip. | Equipment bearing type |
|---|---|---|---|---|---|
| 1. | Limestone Crusher | Radial ring | 4 | (2 Nos.)<br>1 at DE &<br>1 at NDE | As per manufacturer's design |

Vibration shall be measured at each location in Horizontal as well as vertical direction.

4.9.6 Specification of the Vibration Monitoring System

a) Number & type of vibration — One (1), Microprocessor based, monitoring system able to distinguish between high frequency vibration caused by bearing trouble and low frequency vibration caused by imbalance.

b) Number of channels — 16 (Rack mounted in cabinet)

c) Transducer
   a) Velocity pick-up or a peizo-electric accelerometer. Type shall be decided during detail engineering based on the details of equipment to be monitored.
   b) Light weight stud mounting.

| | | | |
|---|---|---|---|
| | | | c) Frequency response 1 Hz -10 kHz. |
| | d) | Connecting cable | Low noise fire proof coaxial cable to be laid in flexible conduit. |
| | e) | Monitors (to be located in FGD control room) | Dual channel monitor for each location alongwith :<br>a) Buffered signal output and software for vibration analysis through FGD control desk HMI.<br>b) Recorder signal output |
| | f) | Display | Analogue and digital |
| | g) | Alarm | 0-100% full scale adjustable. |
| | h) | Trip | 0-100% full scale adjustable. |
| | i) | Test | Functional checking from front inhibiting alarm & trip |
| | j) | Relays | 0.25 A at 220 Volts DC or 5 Amp at 240V AC. Independent potential free contacts for alarm & trip purpose. |
| | k) | Signal Conditioner | Individuel 4-20 mA DC analogue output. |
| | l) | Power Supply | 240 V ±10% AC, 50 Hz + 3%, -5% |

**4.10.0 VIBRATING FEEDER**

**GENERAL**

Vibrating feeder shall be provided below the crusher for limestone.

**4.10.01 CODES & STANDARD**

The design, manufacture, inspection and testing of Vibrating Feeder shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Vibrating Feeder shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Project Manager shall be final and binding. IS:3823 - Dimensions for vibrating conveyors and feeders with rectangular or trapezoidal trough.

**4.10.02 DESIGN REQUIREMENTS**

The vibrating feeder shall be of electromechanical type and shall be provided to feed imestone to crusher. The drive unit shall be complete with mechanical type of vibrator. The vibrating feeder shall be suitable for lumps size of (-) 250 mm. The feeder shall be designed to feed limestone to the conveyor without material sticking to it. The flow of material shall cease as soon as vibration of the trough or pan ceases.

**4.10.03 CONSTRUCTION REQUIREMENTS**

The vibrating feeders shall be mounted on the floor or suspended from roof with the help of helical springs made of alloy steel. No rubber/synthetic material for the support shall be acceptable.

Vibrator bearings shall be grease lubricated, double spherical roller type suitable for vibrating equipment. The bearings shall be sized for minimum 8,000 hours of operation.

Vibrating feeders shall be provided with removable abrasion resistant liner plate.The Vibrating Feeder shall conform to the latest edition of standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted:

IS:8723 - Dimensions for vibrating conveyors and feeders

**4.11.0 PADDLE FEEDER**

4.11.1 Paddle Feeders shall be supplied and erected complete with rails including necessary supporting structures, approach/maintenance platforms with hand railings and ladders, cable reeling drums with trailing cable, cable trays, all electricals including machine mounted local control panel.

4.11.2 **Codes and standards**

i. The design, manufacture, inspection and testing of Paddle Feeders shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Paddle Feeders shall conform to the latest edition of the Indian standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.

4.11.3 **Design requirement**

i. Travelling paddle feeders of self-contained, self-propelled design shall be furnished and erected to scoop out limestone from the hopper and each feeder shall be capable of travelling back and forth along the entire length of the hopper and transfer the limestone from the hopper uniformly onto the conveyors below. Each paddle feeder shall have capacity to scoop out limestone at the guaranteed capacity in both forward and reverse motions with no indication of wheel slipping (water tank full). Each paddle feeder shall be designed for guaranteed capacity while handling entire range of lump sizes.

ii. It shall operate on the principle of positive discharge and shall not depend on friction or moisture content.

iii. The Paddle wheel shall be driven by a step less hydraulic drive. Carriage travel shall be achieved through electric motor gearbox (2 speed) and flexible coupling or through hydraulic drive or electric geared motor (2 speed).

iv. All equipment shall be designed to withstand any rate of acceleration imparted by drives or any strain resulting from a sudden change in load. Further, the design of paddle feeder carriage should be such that it does not run off from its rails due to sudden change in load or other reasons.

v. The Contractor shall include in his proposal necessary electricals for paddle feeder and carriage such as motorized cable reeling drum with trailing cables, and end limit switches for protection against over travel of the feeder carriage. Two separate cable reeling drums one for Power cable and one for Control cable shall be provided for each machine. The cable reeling drum and trailing cable of each feeder shall be suitable for the entire length of the hopper upto maintenance bay. Mechanical track stops alongwith buffers on each end of rails and on paddle feeders shall also be provided. For specification of dust suppression equipment for paddle feeder, refer relevant Sub-section of this Specification.

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vi. For designing the paddle wheel as well as travel drive, Contractor shall consider the hopper fully loaded with limestone on either side of the paddle wheel to the maximum capacity. The hydraulic system normal average working pressure shall be selected considering the above loading condition. Further hydraulic system shall be designed to stall / trip beyond a certain pressure above the normal average working pressure. The minimum margin between the normal working pressure and the stall / trip pressure shall be 50%. The maximum working pressure for the hydraulic system in Hydraulic power pack shall not be more than 210 bar.

vii. Feeder carriage drive shall be suitably designed so that the forward & reverse movement of carriage can be achieved without stopping the scooping operation. Tank filled with water in DS system shall also be considered for travel drive. Capacity of tank mounted on tail end side shall be sufficient for half an hour operation.

viii. Rail structure shall be designed considering two-wheel support and accounting no frictional force from the other two wheels and considering hydraulic motor stall condition.

ix. For selection and specification of drive motors (other than the hydraulic motor), gearboxes, all types of couplings associated with paddle feeder and other equipment, relevant sections of this specification shall be referred to.

x. Contractor's design of paddle feeder should not incorporate a separate loading table (impact cradle) below the paddle feeders. However, the height of fall of limestone between paddle wheel and conveyor belt shall be kept minimum. Hydraulic components shall be provided with dust proof cover for protection against spillage of lime/ dust. Pressure /Temperature gauges shall be located at convenient locations for continuous observation by operator. Proper oil level gauge to be provided at hydraulic oil reservoir tank.

xi. Three (3) pairs of Control cables shall be provided in the control trailing cable of each machine for connecting Employers telephone and P.A. equipment to be provided on each machine.

xii. For Hydraulic system, in case the oil temperature is high then proper external cooling is to be provided , viz, heat exchanger, before the oil returns back to the oil tank.

4.11.4 **Construction requirement**

i. The paddle feeders shall run on rails mounted on the supporting structures of associated conveyors. Both paddle feeder and carriage drives shall be mounted on the feeder carriage.

ii. The paddle feeder wheel shall comprise of suitable numbers of vanes with cutting edges. The vanes shall be of high strength steel construction with removable TISCRAL / SAILHARD / LSLAS07 liner plates. Vanes shall be easily removable individually. Tip of the vane shall reach inner most point of hopper table.

iii. The feeder carriage shall be of steel construction and of robust design. Skirt plates shall be provided integral with the equipment for collecting the material drawn by the paddle feeder from the storage shed hopper and discharging on to the conveyor belt. Feeder skirts of paddle feeders shall be extended at least by 500 mm on either side of the paddle wheel to avoid spillage of limestone. Necessary baffle/retainer plates for suitably guiding the flow of limestone from storage shed hopper to the reclaim conveyor being fed by paddle feeders shall be provided. Hand railing shall be provided on the top deck of feeder carriage together with an access ladder.

iv. The feeder carriage shall be provided with suitable number of double flange wheels of steel construction, complete with sealed bearing unit. The drive mechanism shall be suitable for continuous reversible motion of the carriage. Start/stop switches shall be provided at the local control panel for the operation of paddle wheel and feeder carriage. The carriage shall automatically reverse its motion, when two paddle feeders operating on the same track come within a predetermined distance. Suitable anti-collision device (infrared and mechanically operated limit switch type) shall be provided. Provision shall be made to trip the limestone conveyor from respective paddle feeder and provision shall be made for tripping of paddle feeder from LHP main control room.

v. Rope actuated stop switches shall be provided along the travelling structure for emergency use.

vi. Suitable indication of paddle wheel 'rpm' shall be provided on the paddle feeder control panel and flow rate indicator of belt weigh scale shall also be duplicated on control panel of paddle feeder. Operating controls shall be mounted at a suitable height such that it can be operated from walkway. Encoder shall be provided on the paddle feeder to give 4-20 mA signal to the DDCMIS to the exact location of the machine.

vii. Suitable rail cleaners shall be provided at the leading as well as trailing side of the feeder carriage for both tracks.

viii. Suitable cable trays/troughs shall be provided along the travel of paddle feeder for supporting and guiding the trailing cables. In order to save flexible cables from damage due to tension/over-tension protection switches shall be provided. Isolating switch to isolate the power supply to the machines shall be provided in each power JB to be located at the center of travel length.

ix. Various equipment of Paddle Feeder assembly shall be easily accessible. It shall be possible to replace electrical, mechanical and hydraulic components of paddle feeder when positioned at hopper. Various drive equipment and hydraulic/other components shall be so arranged that limestone spillage from hopper mouth does not accumulate near/over them.

x. Provision shall be kept for automatic tripping of limestone conveyor in the event of paddle feeder getting dragged (i.e. travel speed in excess of rated speed). Paddle feeder once tripped due to jamming or operation of emergency push button shall not start unless the hydraulic pressure is back to "normal".

xi. Paddle feeders rails should be mounted on continuous running member. The splicing of rails shall necessarily be at vertical support location only. Splicing in between vertical support will not be accepted.

xii. The longitudinal distance between two vertical supports shall be 3000 mm (min.)

**4.12.0 LIMESTONE SAMPLING UNIT**

4.12.1 The limestone Sampling Unit shall conform to the latest edition of standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.

**ASTM-D-2234 : Standard Methods for collection of a Gross Sample of Coal.**

ASTM-D-2013 : Standard Method of Preparing Coal Samples for Analysis

ASTM-C-50: Standard practice for sampling, sample preparation, packaging and marking of limestone and limestone products.

4.12.2 The Limestone sampling units suitable to give "Samples" conforming to ASTM-D-2234 shall be selected by the Contractor for taking samples from any of the two streams running at guaranteed capacity. The different Equipment selected for Limestone sampling unit shall be such that there shall be no loss of fines and moisture from the samples. The normal input feed size shall be considered as (-) 250 mm for limestone sampling unit before limestone crusher. However occasionally (-) 400 mm lumps may also arrive. Limestone lump size after limestone crusher shall be as per crusher output size.

4.12.3 Primary samplers (separate for each conveyor) shall be rugged, able to withstand severe shock loads and operate trouble free. Belt feeders shall be provided for entire sampling path upto sample collector. For rejects path also, belt feeders shall be preferred. Screw conveyors for the same shall be accepted only where space constraints do not permit distribution of limestone rejects to receiving conveyor below. Sample crushers shall be provided for reducing the main input feed limestone to 95% minus 8 mesh size and 99 % minus 4 mesh size. Single stage crushing shall be provided. There should be no re-circulation of fines in the crushers. 'Lot size' shall be equivalent to limestone quantity handled in 8 hours operation assuming average conveyor loading at 75% of rated conveyor capacity.

4.12.4 Belt feeders shall be positively self cleaning and have dust tight construction. It shall be provided with flanged belt, rubber lagged head pulleys and inspection doors. No chain/belt drives shall be accepted. The crusher's base should be built of reinforced concrete and be sufficiently large in mass. The sample chutes shall have minimum valley angle of 60 degrees to horizontal and shall be of stainless steel plates. The chutes shall be suitable to handle wet sticky limestone as specified elsewhere. The welding of chutes shall be done externally only. The inside surface of the material near welds shall be smooth. Radius at corners not less than 1" shall be provided in chute work. All solid connected members shall be by means of bolting flanges with at least 6 mm thick standard grade neoprene gasket material between the metal flanges. No control gates to regulate the flow of material shall be incorporated in the chute work.

4.12.5 Bias connections shall be provided at suitable locations. The materials rejected from samplers shall be returned to main conveyor stream. Minimum 4 nos. sample collecting bins shall be provided with auto indexing. The bins shall be provided with air tight connection. The system shall be suitable for operation through DDCMIS.

**4.13.0 DUST CONTROL AND MISCELLANEOUS SYSTEM**

4.13.1 The dust control system to be furnished under this specification is required for control of fugitive dust emissions from dust generation points such as junction towers, truck un-loading points, crushers etc. Dust control is achieved by dust extraction system. Service water system, potable water system, cooling water system & sump pumps shall also be provided. *All pumps/ compressors envisaged to meet dust control and miscellaneous system requirements for LHP/GHP shall be provided with 100% standby.* Each pump houses shall have one no. dedicated over ground tank. Each tank shall be sized for ½ hour storage capacity considering maximum water drawn in order to meet the specified requirement. Tank shall be completely enclosed and provided with man hole and access ladder (internal and external). All areas around tanks shall be paved with concrete and shall have proper drain.

4.13.2 **Service Water and cooling Water System**

Service water and Cooling water distribution system (for scoop coupling) complete with water supply system, valves, quick couplings, hose pipes with nozzle, piping, pumps, drive motors with canopy, couplings with enclosure, electricals, including supporting structures,

handling for equipment's, civil and structural works and necessary accessories shall be provided throughout the limestone handling system.

4.13.3 The Dust Control & Miscellaneous Systems shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted

| | | |
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| IS:778 | : | Gun Metal gate, globe & check valves for general purpose. |
| BS:5150 | : | Cast Iron Gate Valve for water works purposes |
| BS:5152 | : | Cast Iron Globe Valve for water works purposes |
| BS:5312 | : | Cast Iron Check Valve for water works purposes |
| S:1239 | : | Mild Steel tubes & fittings. |
| IS:2379 | : | Colour for the identification of pipe line. |
| IS:3589 | : | Electrically welded steel pipes for water, gas & sewage (200 to 2000 mm) |
| IS:5312 | : | Swing check type reflux (non return) valves. |
| IS:1520 | : | Horizontal centrifugal pump for clean, cold fresh water. |
| IS:5120 | : | Centrifugal pump for clean, cold & fresh water. |
| IS 2825 | : | Air Receivers. |
| ANSI B 31.1 | : | Code for pressure piping. |

Hydraulic institute Standards of U.S.A

4.13.4 Sump pumps alongwith level switches & piping upto nearest Employer's drain (max upto 50.0 mtrs. from outside the building) shall be provided at all locations wherever natural drainage is not possible. The capacity of each pump shall not be less than 50 $m^3$/hr. Minimum 10% margin on capacity and 20% margin on computed head shall be considered for selection of pumps. Size of the drain pit shall not be less than 2.0 meters x 2.0 meters x 1.8 meters deep. One no. of settling pit shall also be provided before sump pit so that water without heavy limestone particles goes into sump pump pit. High and low level switches shall be provided in the sump pump pit.

4.13.5 Service water connections are to be provided in conveyor galleries and tunnels at 50 meter intervals. Adequate number of these connections shall be provided in all junction towers with minimum one no. at each floor and with minimum two (2) nos. at each floor in limestone crusher house. Each connection shall be provided with one (1) no. 32 NB globe valve and quick coupling. One (1) no. hose pipe with nozzle shall be provided in each building.

4.13.6 Potable water connections are to be provided in all junction towers, limestone crusher house, all tripper floors, and all control rooms/MCC rooms and toilets etc. Water shall be drawn from the water storage tank by electric motor driven pumps and discharged via a pipe work system to the overhead drinking water storage PVC tanks of 250 litres capacities. The drinking water storage tanks shall have provision for maintenance & drain.

4.13.7 Hoists with monorail of adequate capacity shall be provided in the service water/dust suppression/potable water pump houses

4.13.8 The pumps shall be complete with drive motors, base plate and other accessories. Pump casing may be axially or radially split. Impeller shall be made in one piece and securely keyed to the shaft. Wearing surface shall be of hardened material and shall have a hardness difference of at least 50 BHN. The design of the shaft shall take into consideration the critical speed, which shall be at least 20% away from operating speed. Pump bearings shall be of antifriction type. Pump speed shall be less than 1500 rpm for pumps of capacity more than 10 $m^3$/hr. The power, head and flow characteristics of each pump shall be suitable for parallel operation. The Power characteristics of the pumps shall be of non overloading type. All rotating parts of the pumps shall be statically and dynamically balanced. Design duty point of pump shall match with the average value of maximum and minimum flow rates of the pump in the stable operation zone.

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| 4.13.13 | The sump pumps shall be of wet pit types, vertical shaft and impeller shall be specially designed to pass large solids or unscreened liquids. The construction and material shall be suitable for pumping limestone/dust contaminated water with a minimum of maintenance. All bearings of the pump shall be located above the water level. |
| 4.13.14 | In general pipe sizes 65 mm NB and larger are to be joined by butt welding and pipe work of size 50 mm NB and below by socket welding/screwed connections. Joints at valves or specialities shall be flanged for sizes 65 mm NB or large and screwed for sizes 50 mm NB and below. All galvanised piping shall be joined by screwed connections. Minimum pipe diameter selected for DS/SW/PW/Cooling Water System (along with branch pipes) shall be 32 NB. However, for dry fog DS system, the minimum pipe size shall be 20 NB. |
| 4.13.15 | Valves & Specialities shall be used to start, stop or regulate the flow. All valves/specialities below 50 mm size in service water/dust suppression/ potable water lines should be plug type. Gate/sluice valves shall be used for isolation of flow of pipe lines above 50NB and Globe valves shall be used for regulating the flow. All gate and globe valves of size 65 NB and large shall be bolted bonnet, outside screw, rising type with flanged ends. Valves of size 50 NB and smaller shall be with screwed ends. Non-return valves shall be swing check type. These valves will have a permanent 'arrow' inscription on its body to indicate direction of motion of the fluid. |
| 4.13.16 | Strainer shall be of duplex type designed with 3 way valves so that one filter can be cleaned while the other is in operation. Suitable vent and drain valves shall also be provided. Screen opening area shall be at least four times the pipe cross sectional area. Pressure drop in clean conditions shall not exceed 1.5 MWC at full flow. |
| 4.13.17 | The dust control and miscellaneous system to be supplied for limestone handling plant may be clubbed with the dust control and miscellaneous system for coal handling plant under this package. |
| **4.13.18** | **Dust extraction system for Limestone Handling area:**<br><br>Dust extraction system for limestone handling system shall be dry type comprising of dust collection hoods, ducting, fans, bag filter and dust collection hopper. The limestone dust collected in dust collection hopper shall be periodically emptied back to the conveyor leaving the building. |
| 4.13.19 | Limestone storage area dust extraction system:<br>a) For dust control in limestone storage shed during stacking and handling of limestone, roof extractors, ducting and collection hopper with bag filters shall be provided. The dust collected in the dust collection hoppers shall be periodically emptied back to the reclaim conveyor below the shed.<br><br>b) For the paddle feeder provided for the reclaim hopper below the limestone storage shed, the dust extraction system comprising of suction hood, ducting and trolley mounted dust collection hopper with bag filters shall be provided. The dust collection hopper shall be periodically emptied back to the reclaim conveyor. |
| **4.14.0** | **VENTILATION SYSTEMS** |
| 4.14.1 | **Mechanical Ventilation system**<br><br>The air quantity for mechanical ventilation system shall be estimated based on equipment and solar heat loads and the temperature rise inside the building. Necessary air filters shall be provided to supply only clean air into building. Exhaust air shall be discharged at a suitable height above building. The ventilation system generally consisting of adequate number of supply and exhaust air fans, air filters, ducting along with 3 phase AC motor |

drives, electricals, supporting structures, approach/maintenance platforms, civil and structural works and necessary accessories shall be furnished for ventilating the underground portion of junction towers, underground conveyor tunnels. Exhaust fans shall be provided for tripper floor, Toilets, Battery rooms. The exhaust fans for toilets and battery rooms will be propeller type and for tripper floors will be axial flow type complete with rain protection cowl and bird screen.

4.14.2 **Pressurised Ventilation System**

The pressurised ventilation system having adequate nos. of supply air fans with washable metallic pre filters, HDPE fine filters, and self closing flap (gravity louver shutter), ducting along with 3 phase AC motor drives, electricals, supporting structures, access / maintenance platforms shall be provided in all MCC/switchgear room areas of limestone handling plant to be furnished under this specification. The pressurized ventilation system shall be designed considering 15 air changes per hour to maintain these areas pressurised slightly above atmospheric pressure to prevent ingress of dust from outside

4.14.3 Air Conditioning System

Air conditioning system shall be furnished for control room area of main LHP control building (if applicable) and in electrical buildings. It shall be designed considering the equipment heat loads, solar heat loads, heat gain into the room, adequate no. of air changes etc. to maintain a uniform temperature and relative humidity within the air conditioned areas.
2x100% capacity air conditioning units with air cooled condensers shall be provided on the following basis.
a) For areas where air conditioning load is in the range of 5-15 TR, Non-ductable ceiling mounted (cassette type) or wall mounted (high wall type) split air-conditioners of suitable capacity along with adequate redundancy shall be provided.
b) Ductable split/packaged type A/Cs shall only be provided for control rooms where the load varies in the range 15- 25 TR.
c) Central air conditioning system shall be provided for control rooms where the load varies in the range 25-60 TR.

Window ACs shall be provided for RIO room (if applicable). Supply and return air distribution ducting complete with insulation, of resin bonded mineral wool equivalent of density at least 24 kg/m$^3$ and thermal conductivity of max. 0.49 mw/cm°C conforming to IS: 8183 including supporting structures, approach/ maintenance platforms, civil and structural works and necessary accessories shall be provided.

4.14.4 The Ventilation & A/C System shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.

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| IS:3588 | : | Specification for electrical axial flow fans. |
| IS:2312 | : | Propeller type AC Ventilation fans |
| IS:3963 | : | Specification for roof-extractor units |
| IS:4894 | : | Centrifugal Fans |
| IS:655 | : | Specification for Metal Air Duct |
| ARI:210 | : | Standard for Unitary air conditioning equipment. |
| ARI:270 | : | Standard for application, installation and servicing of unitary equipment. |
| IS:8183 | : | Specification for bonded mineral wool. |
| IS:661 | : | Thermal insulation for cold surfaces. |
| IS:4671 | : | Expanded polystyrene for thermal insulation purpose. |
| IS:8148 | : | Packaged Air conditioners |

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4.14.5 **Axial Fans**

Design duty point of the fan shall match with the average value of maximum and minimum flow rates of the fan in the stable operation zone. The speed of the fan shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1440 rpm for fan with impeller diameter 450 mm and less. The first critical speed of rotating assembly shall be at least 25% above operating speed. Impellers shall be axial flow type and single piece cast aluminum with aerofoil blades construction and shall be mounted directly on the motor shaft. It shall be finished all over and balanced dynamically. Rain protection cowls will be designed to suit wall exhausters/supply fans for protecting fans/motors from rain. It will be provided with bird screen. Inlet cone or bell and outlet cone shall be provided as required. It should be made of G.I. or M.S.

4.14.6 **Centrifugal Fans**

The fan units shall be centrifugal type with radial bladed impeller. For design, purpose out door ambient temperature shall be taken as 50 deg.C. All fan mountings shall have adequate arrangement for vibration isolation. The reverse flow through non-working fan shall be prevented by dampers. The dampers shall be made out of 18 SWG MS sheets. Design duty point of the fans shall match with the average value of maximum and minimum flow rate of the fan in the stable operation zone. Split casing shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required. The impeller shall have die formed curved blades fabricated out of MS heavy gauge welded to the rim and back plate to have a non overloading characteristics of the fan. Rim shall be spun to have a smooth contour. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts. The impeller along with driven pulley shall be dynamically balanced. Fan shaft shall be of EN-8 equivalent. The bearings shall be self-aligning heavy-duty ball or roller bearings. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside

4.14.7 **Metallic Filters**

Metallic cleanable filters shall be provided as required. Max. air velocity considered shall be 2 m/sec. Metallic cleanable filters shall consist of V-fold galvanized wire mesh inter spaced with a flat layer of galvanized wire mesh. The density of the filter medium shall increase in the direction of airflow. Wire mesh edges shall be suitably hemmed to eliminate the danger of abrasion during handling. Filter medium shall be supported on either side by galvanized expanded metal casing. Filter frame shall be constructed from galvanized sheet of thickness not less than 18 gauge.

4.14.8 **HDPE Filters**

HDPE filters should have an efficiency of 90% down to 5 microns. Velocity across the filter shall be limited to 2.5 m/sec. HDPE filters shall be provided as required. To facilitate periodic cleaning of filters by water washing, tap or service water connection near the filters shall be provided.

4.14.9 **High efficiency filter (for A/C purpose)**

High efficiency filter (for A/C purpose). Filtration efficiency shall not be less than 99% down to 5 microns. Pr. drop across the filter under clean condition shall not be more than 10 mm w.c. The media of the filter shall be made from either special synthetic non-woven bond fiber design or made from micro fiber glass media. It shall be supported with GI wire mesh or aluminum mesh and shall be housed in an aluminum sheet frame. It shall be of washable type several times.

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4.14.10 **Packaged Air-Conditioning Unit**

PAC units shall be factory tested and assembled self contained units complete with refrigerant compressor, coils, fans, insulation and wiring. Various parts of PAC units wherever required shall be insulated with expanded polyethylene conforming to IS:4671. The PAC unit shall comprise of an evaporator (indoor air) blower section and an air cooled condenser (outdoor air) section. Heavy gauge steel cabinet finished with paint of approved colour, shall be used to house components of PAC. The evaporator and condenser coils shall be arranged for direct expansion cooling and shall be formed of aluminum fins mechanically bonded to seamless copper tubes and electrically tinned. The inter-connecting refrigerant circuits shall comprise of hermetically sealed scroll compressor and motor with all necessary isolation valves, with adjustable set point, sight glass, copper tubing and pipeline ancillaries. The condenser coils shall be air cooled by propeller type fans complete with safety guards. The condensing coils The evaporator air blower(s) shall be centrifugal forward curved type belt driven by individual motor(s) and suitable for the external static pressure. The fan assembly shall be isolated from the casing by anti-vibration mounts. The fan/motor drive shall be capable of capacity adjustment by pulley changes within +15% of design duty shall be suitably arranged to avoid radiant heat pick-up from solar sources. Condenser capacity control shall be provided by means of fans and 'head pressure' sensing. High efficiency filters shall be provided in the main supply air duct and in the fresh air connection to return air duct.

A separate cubicle shall be provided within the overall casing to house the thermostatic controls, which shall be electric/electronic solid state, prewired and tested. The refrigerant system shall be protected by pressure limiting devices, electric and thermal overloads and unloading facilities to provide the required control range tolerances. A low voltage room thermostat or RTD based temperature sensing device shall be provided for wall mounting. The casing shall be fitted with all necessary coil drains and service connections/ entries. PAC (duty/standby) units shall be selected manually and be ON/OFF switched. The units shall be fully packaged and incorporate integral room air sensing control thermostats and manufacturers work fitted safety interlocks. All controls shall be prewired to unit mounted control/power terminal boxes.

4.14.11 **Ventilation and Air Conditioning system ducting**

All GI sheet metal ductwork required for ventilation and air conditioning system shall be furnished by the supplier. All ducts and plenums unless otherwise noted shall be constructed out of standard quality galvanised steel sheet. All sheet metal ducts shall be fabricated and installed in conformity to the requirements of IS: 655. Steel supports for the ductwork shall be furnished as required. The thickness of ducting steel shall be 1 mm min. For ducting with large size exceeding 1000 mm it shall be 1.2 mm. The flexible connection between fan and ducting shall be on teflon impregnated canvas. The zinc coating on GI sheet shall be 275 gm/$m^2$

**4.15.0 BELT SCALE**

4.15.1 The Belt Scales shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.

**NEMA**

**NEC** **For electronic circuit enclosures.**

IS:11547 Electronic weighing in motion system

4.15.2 The weigh scale shall be automatic and electronic type. It should be designed for continuous automatic weighing, metering and printing of limestone flow. Each belt weigh scale shall

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| | comprise of a belt weigh scale platform with minimum 4 nos. weighing idlers. It shall have unitised construction for ease of installation and shall be fully floating type (without pivot points). Minimum 4 nos. hermetically sealed load cells of precision strain gauge type shall be applied in tension to support the weigh bridge. The load cells shall have 100% overload protection and shall be structurally safe upto to 250% of rated belt scale capacity. Belt scale shall be electronic microprocessor based with its program stored in non-volatile memory. It shall be provided with self diagnostic features for trouble shooting of the entire belt scale system. Fully automatic zero and span calibration facility shall be provided. The flow rate indicator shall have minimum 4 digits. The flow totalizer should have 8 digits display scale with reset facility. Complete belt scale system shall be suitable for 50°C ambient temperature and 100% relative humidity. It shall be suitable for out door installation in a dusty area. The electronic circuit enclosure, sensors housing shall be dust and watertight. The electronic printed circuits shall be encapsulated with epoxy or other suitable material for protection against dust and moisture. Minimum three years battery back up power failure protection shall be provided. |
| 4.15.3 | Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of atleast (±) 0.25 percent throughout its range. Per two (2) belt weighers, the contractor shall furnish one (1) necessary test load chain sets required for calibration and periodic testing of the equipment. The test load chain shall be 'two idler spaces' longer than the weighing length of the weighers and shall be complete with chain reset equipment with weight adding reels of adequate size. The calibrated weight parameter length of the test chain shall be stamped at a suitable location on the body of the equipment. Alternatively, supply of test weights for calibration of belt scales is also acceptable. |
| **4.16.0** | **IN-LINE MAGNETIC SEPARATOR AND SUSPENDED MAGNET** |
| 4.16.1 | Inline Magnetic Separators shall be provided for continuous and automatic extraction and discharge of tramp magnetic pieces from limestone being discharged from conveyors as specified. The sets shall be complete in all respects with drives, magnets, inline belts, hoppers, chutes, tramp-iron boxes and all electrical ancillaries like control panels etc. Suspended Magnetic Separator shall be provided for picking up tramp magnetic pieces buried under limestone from moving Conveyor. |
| 4.16.2 | Magnet core material shall be pure annealed iron or equivalent high permeability magnetic material. The coil shall be of aluminum wire with class 'H' insulation, to limit the absolute temperature of the winding to 140 deg. centigrade. The oil used for cooling the ILMS and SM shall be silicon based. |
| 4.16.3 | The 'Force Index' i.e. the product of flux density in gauss and rate of change of flux density w.r.t. distance, at the bottom of falling material trajectory shall be 100,000 (gauss x gauss/inch) minimum in hot condition for mounting height of 450mm in the conveyors carrying uncrushed limestone & 400 mm in the conveyors carrying crushed limestone. However, the strength of the magnet shall not be less than 1000 gauss in hot running condition at distance of 450mm in the conveyors carrying uncrushed limestone & 400 mm in the conveyors carrying crushed limestone. The minimum strength of the magnet shall be 1000 gauss at the specified mounting height at the centre of Belt width. Contractor shall select magnet width to suit above. Characteristic curve of magnet with the value of flux density varying between 50 mm to face of conveyor belt shall be provided. The cross section of magnet shall be suitably designed to provide sufficient area for magnetising the coil effectively covering full cross section of the discharge material. The magnetic separator shall be located such that it picks-up tramp iron from limestone trajectory after it has been discharged from head pulley. |
| 4.16.4 | The tramp magnetic pieces buried under limestone picked up by the magnetic separator shall be discharged suitably to ensure that it falls into the tramp iron chute, which shall be provided upto ground level. All conveyors with magnetic separator at head end shall have non-magnetic SS pulleys. Head pulleys of all conveyors with in line magnetic separator at |

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| | head end shall be provided with SS shell and end disc. However, hub and shaft shall be of same materials as in other pulleys (EN-8 or equivalent). The motor and the gear reduction unit for driving the in-line belt shall be adequately sized with minimum 20% margin to avoid any over loading during operation. Suitable zero speed switch shall be provided. No Chain/belt drives shall be accepted. The belt shall be designed to withstand high temperature at the bottom of the magnet and any serious damage due to the impact of the sharp edges of the tramp iron. The belt shall be provided with rubber cleats spaced suitably. The belt shall be of fire resistant grade. |
| 4.16.5 | The magnetic separator units shall be supported by suitable structural member from the top by taking support from the operating floor beams with turn buckle arrangement to facilitate the necessary adjustments during operation. Further, electric Hoists operated cross travel arrangement shall be provided to move magnetic separator away to facilitate maintenance of the conveyor discharge pulley/Belt. ON/OFF control push buttons with indicating lamps shall be provided at the local station. The materials of chutes and hoppers associated with magnetic separators above the drive floor shall be SS-304 in the magnetic zone. Other chutes shall be of 1 mtr. sq. dimension and shall be made of MS. Chutes shall have poking doors at all floors to clear jammed material. |
| 4.16.6 | Suitable arrangements shall be provided in the magnet for keeping the coil of the magnet dry from atmospheric condensation when the magnetic separator is not in use. Protection against high oil temperature in magnet shall be provided. |
| **4.17.0** | **METAL DETECTOR** |
| 4.17.1 | Metal detectors shall be provided at specified location to detect metallic objects in the limestone stream. Metal detectors shall have high reliability with enough sensitivity to detect 25mm aluminum sphere below the burden of limestone in case of synthetic belting. However, for steel cord belting the sensitivity shall be 35mm. It shall also detect other metals, like brass, copper, stainless steel, manganese steel, bars, scraps etc. The equipment shall have provision for automatic static calibration with adjustable sensitivity. |
| 4.17.2 | Metal detectors shall be completely solid state using latest state of art technology. It shall be suitable for 50°C ambient and RH of 100%. The search sensor shall be protected from rain and direct sunlight by means of a non metallic covering other than wood. Control unit shall have adjustable controls for sensitivity, ON/OFF push buttons, resettable operation counter, audio-visual alarms local remote selector switch and all other necessary controls for trouble free operation of metal detector. It shall be suitable for mounting on wall, column, structure etc. with IP-65 Degree of protection. It shall be constructed from FRP of thickness not less than 2mm. |
| 4.17.3 | The coils shall be protected against being struck by an oversized material. The coils should have adjustment for magnetite/iron in incoming limestone. It should ignore magnetite/iron and shall distinguish between metal pieces and magnetite/iron. In order to counteract interference from external sources such as motors, lightning and radio-transmitters, and to nullify the effect of climate changes/aging, dual receiver coils are to be used. In order to allow passing of steel cord belt and metal belt fasteners without giving alarm and at the same time detecting tramps, suitable arrangements shall be provided. In case a few non-magnetic idlers or non magnetic deck plates are required, the Contractor shall provide these. However, these shall be metallic. Wood is not to be used. LED display of COAST COUNT to indicate the number of pieces of tramp iron detected since last reset shall be provided so that the operator is alerted for the pieces of tramps, if any, between tramp marker and coil before restoring conveyor. TOTAL COUNT, which is not resettable, shall also be provided on the same LED display on demand. The location of tramp metal pieces shall be indicated by sand bag marker. |
| 4.17.4 | Fiber glass enclosure (with IP 65 degree of protection) shall be provided for all type of coils. Local control panel shall be provided with IP:65 degree of protection. |

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**4.18.00 BOX FEEDER OR BULK MATERIAL RECEIVING UNIT OR TRUCK UNLOADING SYSTEM OR SURFACE FEEDER:**

The Box Feeder should be a robust, proven, above the ground for unloading from trucks/ self-tipping trucks or from loader shovels. The unit should be designed for rapid intake and temporary live storage of material before transferring on to the crusher house. The intake and onward discharge capacity to be 200 TPH per Box Feeder.

**4.19.00 BUCKET ELEVATOR SYSTEM**

**4.19.01 General Requirement**

The type (Centrifugal/Continuous) of the Bucket Elevator shall be chosen by Bidder for the material and conditions specified. The Bucket Elevator shall be sized to handle the design capacity at the specified material bulk density & maximum material size. The equipment shall be complete with all necessary sub-systems and components and shall be designed and supplied in conformance with the attached datasheets, site conditions, specific Employer's requirements and applicable International, National, State and Local codes. The Equipment shall be complete in all aspects and all items required for erection/smooth operation shall be in Bidder's scope, unless otherwise noted in exclusions. Sizing of the equipment and components shall be the responsibility of the Bidder, based on the service conditions specified.

**4.19.02 Codes and Standards**

All design, fabrication, testing, supply and erection, if applicable, shall conform to the latest edition of all the relevant standards and regulations issued by the governing bodies.

Bidder shall follow the applicable INDIAN/INTERNATIONAL codes by the following organizations. EN European Norm

IEC International Electro technical Commission

ISO International Organization for Standardization

DIN German Institute for Standardization (To be used when no EN standards exist) Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Employer shall be final and binding.

**4.19.03 Design Requirement**

**4.19.04 Design Criteria**

The equipment shall be designed for continuous twenty-four hour service. The Equipment shall be designed for service in a heavy duty industrial application, handling abrasive materials in a dusty environment.

The Bucket Elevator should be sized to handle the design capacity as indicated on the Data Sheet with the minimum material bulk density and a maximum bucket filling of 75%.

**4.19.05 Casing**

Casing to be self-supported, dust-tight construction and capable of supporting head shaft, drive, and service platform.

Head section is to be split and equipped with handles or lifting lugs for easy removal. Access and inspection doors are to be provided.

Intermediate sections are to have a minimum plate thickness of 4 mm.

Boot section to be fabricated of minimum 6mm steel plate, with front and rear access panels.

A beam is to be provided in casing for servicing internal gravity take-up. The beam may be located either in the boot section or intermediate section as applicable.

**4.19.06** **Buckets**

Size, capacity and type of buckets and appropriate reinforcement necessary for the application shall be adequately sized. Provide pin holes in bottom of buckets for air relief, as necessary, when handling materials such as Lime stone or gypsum. Bucket width is to be a minimum of four times the maximum particle size.

**4.19.07** **Belting**

Belting shall be provided as specified else where in the specification..

**4.19.08** **Pulley**

Drive and guide pulleys shall be provided as specified else where in the specification and shall be at least the minimum recommended for belt conveyor pulleys.

**4.19.09** **Head Shaft and Bearings**

The bearings on head shaft to be antifriction type with one bearing fixed and the other expansion. All bearings are to have an $L_{10}$ life of 60000 hours.

**4.19.10** **Foot Shaft and Bearings**

The tail shaft is to be of hardened steel with tool steel sleeves operating in heat treated white iron bearings. All bearings are to have an $L_{10}$ life of 60000 hours.

**4.19.11** **Take-up**

Take-up shall be screw or internal gravity type with guide rails and weights included.

**4.19.12** **Drive**

Bucket elevator drive should be sized as follows:
Minimum power for drive, either:
100% bucket filling @ minimum material bulk density, or
75% bucket filling @ maximum material bulk density, whichever is greater.

**4.19.13** **Inspection and Access Doors**

Inspection doors and access doors shall be loose-hinged type with quick-opening jamb bar fasteners and gaskets enclosed and retained in the door. Access doors shall be 1.5m minimum.

**4.19.14** **Dust Vent**

A dust collecting vent in the head section and boot section shall be furnished with drilled flanges. Bidder quote is to include recommended vent volumes for the boot and head sections of the elevator. The Pick-Up velocity shall not be greater than 2.5m/sec.

**4.19.15** **Drive Equipment**
The Drive Equipment for Bucket Elevator shall be as specified else where in the specification.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**DATA SHEET for each of above system and equipment is as below :**

## DATA SHEET: BELT CONVEYOR

| | | | |
|---|---|---|---|
| 1.0.0 | **GENERAL** | | |
| 1.1.0 | Design Capacity | 110% of rated (guaranteed) capacity for all conveyors. | |
| 1.2.0 | Maximum slope | 16 deg | |
| 1.3.0 | Max. belt Sag between idlers | 2% | |
| 1.4.0 | Minimum Radius | | |
| | (i) Concave curve | 250 m (In case of travelling trippers, the requirement of minimum radius shall be decided based on the space availability) | |
| | (ii) Convex Curve | 50 m | |
| 1.5.0 | Limestone Parameters | As specified elsewhere | |
| 2.0.0 | **DESIGN & CONSTRUCTION** | | |
| 2.1.0 | **Belting** | | |
| 2.1.1 | Type | Synthetic Fabric of Nylon / Nylon | |
| 2.1.2 | Cover Grade | a) Flame test : Conforming to ISO:340<br>b) Drum Friction and Electrical Surface Resistance Test: Conforming to Canadian standard association CAN / CSA M-422- M87 Grade - C. | |
| 2.1.3 | Cover Thickness (without –ve tolerances). | Synthetic belting | Steel Cord |
| | (a) Face | 5.0 mm (min.) | 8.0 mm (min.) (Inclusive of steel or fabric breaker) |
| | (b) Bottom | 2.0 mm (min.) | 6.0 mm (min.) (Inclusive of steel or fabric breaker) |
| 2.1.4 | No. of plies | Minimum 3 | |
| 2.1.5 | Drive Arrangement | Snub drive | |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET : BELT CONVEYOR** | |
| 2.1.6 | Factor of Safety | - 10 (Minimum) for N-N belt.<br>- 7 (minimum) for Steel Cord Belt. |
| 2.1.7 | Normal Working tension at design capacity | Less than 80% of max. allowable working tension |
| 2.2.0 | **Idlers** | |
| 2.2.1 | Type | |
| | (a) Carrying | Three roll, 35 degree troughing,<br>2 degree forward tilt |
| | (b) Return | Single Roll, For conveyors upto 400 m c/c length. Two roll with 10 degree angle for conveyors more than 400 m c/c length |
| | (c) Loading point | Impact type |
| 2.2.2 | Spacing | |
| | (a) Carrying idlers | 1.2 m (0.6 m for convex curves). |
| | (b) Return idlers | 3.0 m (for convex curves not more than 1.5 m.) |
| | (c) Loading point | Minimum six (6) with 400 mm spacing. |
| | (d) Self-aligning troughing idlers | At 10 m distance from head & Tail pulleys with intermediate spacing 15m |
| | (e) Self - aligning return idlers | At 10 m distance from Head & Tail pulleys with intermediate spacing 20m. (Not required for conveyors more than 400m c/c long where 2 roll return idlers are provided). |
| 2.2.3 | Bearings | |
| | (a) Carrying | Ball Bearings of deep groove type or seize resistance type of min. 30 mm size, lubricated for life. |
| | (b) Return | Ball Bearings of deep groove type or seize resistance type of min. 20 mm size, lubricated for life. |
| 2.2.4 | Material | |
| | (a) Roller | ERW Steel tube min. wall thickness 4.0 mm |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | (b) Spindle | EN- 8 or equivalent. |
| 2.3.0 | Belt Cleaners | |
| 2.3.1 | External | Spring loaded scraper type cleaner with modular, segmented and replaceable PU blades with separate main-cleaner & pre-cleaner etc. |
| 2.3.2 | Internal | V-Plough type, mild steel flats with hard rubber strips. |
| 2.4.0 | Belt Take up | |
| 2.4.1 | Type | Automatic Gravity Type. |
| 2.4.2 | Location | In relation to the drive to keep belt tension at minimum. |
| 2.4.3 | Take-up travel | To suit all operating conditions or (2.5% for synthetic belt and 0.5% for steel/cord belt) of conveyor center to center length whichever is larger. Further the initial location of take-up shall be decided in such a way that it is possible to carryout min. two (2) nos. Vulcanizing Joints without adding any external belt. |
| 2.5.0 | Hold Back Device | Integral with gear Box |
| 2.6.0 | Pulleys | |
| 2.6.1 | General (for all types of Pulleys) | |
| | Pulley shaft diameter | Margin of minimum 20% shall be Considered on maximum tension at design capacity for arriving at the shaft dia. |
| 2.6.2 | Drive Pulleys | |
| | (1) Lagging | Hot lagged with vulcanized natural rubber |
| | (2) Lagging thickness | 12 mm thick grooved in diamond pattern with grooves 6 mm wide x 6 mm deep |
| | (3) Minimum angle of wrap | 210° degrees |
| | (4) Maximum Out of roundness | 0.5% of nominal diameter |
| 2.6.3 | Other pulleys | |
| | (1) Lagging | Hot lagged with vulcanized natural rubber |
| | (2) Lagging thickness | 12 mm thick plain |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| 2.6.4 | Rubber for lagging | |
| | (1) Type | Natural rubber blended with styrene Butadiene rubber. |
| | (2) Hardness | 55 to 65 durometer (Shore A) |
| | (3) Elongation | Over 300% |
| | (4) Strength | 160-245 kg/cm$^2$ |
| | (5) Abrasion loss | 250 mm3 (max.) as per DIN 53516 |
| | (6) Specific Gravity | Max. 1.5 |
| | (7) Adhesion Strength | 10 kg/cm (minimum) |
| 2.6.5 | Bearings for Pulleys | |
| | (1) Type | Heavy duty roller type |
| | (2) Casing | Horizontal Split Type |
| | (3) Sealing | Dust tight with double labyrinth seals. |
| | (4) Lubrication | Greasing arrangement with conical head shape nipples. |
| 2.6.6 | Pulley Material | Mild steel conforming IS:226 / IS : 2062 |
| 2.6.7 | Shaft Material | Forged Steel shaft EN-8 or equivalent material. |
| 2.7.0 | Belt Protection Equipment | |
| 2.7.1 | Emergency Stop Switch System | |
| | (1) Type | Pull chord type (manually reset) |
| | (2) Location | Both sides of conveyor for entire length |
| | (3) Spacing | Approx 30 m |
| 2.7.2 | Belt Sway Switches | |
| | (1) Type | Limit switches snap action. |
| | (2) Spacing | One pair at 50m interval (Minimum two (2) pairs) |
| 2.7.3 | Zero Speed Switches | |
| | (1) Type, Location | Proximity switch, mounted on Bend pulley of GTU. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| 2.8.0 | Drive Motors | |
| 2.8.1 | Type | Three Phase Squirrel Cage Induction Motors |
| 2.8.2 | Mounting (for conveyors) | Base mounted |
| 2.8.3 | Continuous motor rating (Name plate rating) at 50$^{O}$C Ambient | 120% of actual power requirement at motor output shaft at design capacity. |
| 2.9.0 | Conveyor Bridges | |
| 2.9.1 | Walkways | |
| | (a) Construction | Chequered plate with antiskid arrangement.<br><br>Chequered plate steps shall be provided where conveyor slope exceeds 10 degrees. (Totally sealed so that no water falls down while washing.) |
| | (b) Central walkway width | 1100 mm |
| | (c) Side walkway width | 800 mm (for single conveyors, the width of side walkways shall be 800 mm on one side and 1100 mm on the other) |
| 2.9.2 | Side Windows | |
| | (a) Spacing (Center to center) | 25.0 m on each side (in staggered fashion) |
| | (b) Size | 1.2 m x 1.5 m |
| | (c) Window material | Refer Civil Section |
| 2.10.0 | Trestles | |
| 2.10.1 | Spacing of monkey ladders on trestles | |
| | (a) Where height of conveyor gallery (walkway level) is 10 m or more. | : On every trestle |
| | (b) Where height of conveyor gallery (Walkway level) is less than 10m. | : On alternate trestle |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|

## DATA SHEET: BRAKES AND CLAMPS

| | | |
|---|---|---|
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Brakes | (i) For decelerating of conveyors & rotating equipment's.<br>(ii) Brakes are mandatory for H.T. drives involving scoop type coupling. |
| 1.2.0 | Rail Clamps | For various mobile equipment travelling on rails. |
| 2.0.0 | **DESIGN & CONSTRUCTION REQUIREMENT** | |
| 2.1.0 | **Brakes** | |
| 2.1.1 | Type | Electro Hydraulic Thruster brakes A.C. operated or Disc brakes. |
| 2.1.2 | Braking Torque | Adjustable from 0 to 100% of rated braking torque. |
| 2.1.3 | Brake Shoes | Operated directly by spring |
| 2.1.4 | Shoe lining | Asbestos with interwoven brass wires. |
| 2.1.5 | Max. Temperature for shoe lining | 200 degree C. |
| 2.1.6 | Thrustor | Class-B insulation, IP-65 protection. |
| 2.2.0 | **Clamps** | |
| 2.2.1 | Rail Clamp support | Independent from the rails. |
| 2.2.2 | Limit Switches | "ENGAGED" & "DISENGAGED" signals. |
| 2.2.3 | Clearance between Rail clamp face & Rail surface | Minimum 50 mm |
| 2.2.4 | Material for Rail clamp Mechanism | Forged steel |
| 2.2.5 | Thruster | Class-B insulation, IP-65 Protection |
| 2.2.6 | Type | Electro hydraulic thruster, manual |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: MONORAILS AND HOISTS** | |
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Functional Requirement : | To transfer equipment's to maintenance area or outside the building. |
| 2.0.0 | **DESIGN & CONSTRUCTION REQUIREMENT** | |
| 2.1.0 | **Hoists** | |
| 2.1.1 | Drive | |
| | (i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings | Motor driven for both travel & lift. |
| | (ii) Other hoists including the hoists for handling takeup pulley and takeup weight | Manual for both travel & lift. |
| 2.1.2 | Maximum trolley travel speed for electric hoists | 15m/min |
| 2.1.3 | Maximum Hoisting speed for electric hoists | 6 m/min |
| 2.1.4 | Drive Motors | SQIM, Separate for travel & lift |
| 2.1.5 | No. of starts for drive motor | 150 starts/hr at 40% CDF |
| 2.1.6 | Wire Rope | |
| | (i) Type/Construction | Pre-formed type, hemp cored, regular lay 6/36 construction |
| | (ii) Breaking Strength | 160-175 kgf/sq. mm |
| 2.1.7 | Bearing | |
| | (i) Type | Ball/Roller bearing |
| | (ii) Life | 20 years |
| 2.1.8 | Brake | Electro Mechanical type with asbestos lining. |
| 2.1.9 | Load Hook | Swiveling type forged circular shank section. |
| 2.1.10 | Duty | Class –2 |
| 2.2.0 | **Monorail location/layout** | |
| 2.2.1 | Cross section | I beam |
| 2.2.2 | Distance between C/L of monorail & C.G. of equipment to be lifted | Maximum 500 mm |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| 2.2.3 | Power Cables Support | Festoon type arrangement |
| 2.3.0 | **Manual Hoists** | |
| 2.3.1 | Maximum manual effort for operation. | 30 kg |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: CHUTES AND HOPPERS** | |
| 1.0.0 | **GENERAL** | |
| 1.0.1 | Limestone Parameters | As specified elsewhere |
| 2.0.0 | **DESIGN & CONSTRUCTION** | |
| 2.1.0 | **Chutes & Hoppers** | |
| 2.1.1 | Minimum Valley Angle | 60 degrees |
| 2.1.2 | Material : | |
| | (a) Chute work | |
| | (b) Sliding zones & adjacent sides | 20 mm thk. TISCRAL / equivalent |
| | (c) No striking/ Non sliding zones | 10 mm thk MS |
| | (d) Chute with valley angle 80 degree and above | All four sides of 20 mm thk. TISCRAL/equivalent material |
| | (e) In the zone of magnetic field of ILMS (chute above floor over which ILMS is suspended) | SS-304 10 mm thk. |
| | (f) In the zone of flap gates | 20 thk TISCRAL/ equivalent material |
| | (g) Discharge Hoods over head pulleys | 4 mm thk M.S. with rubber curtain |
| 2.1.4 | Inspection Doors | Hinged & leak proof construction (min. size 350 x 450 mm) |
| 2.1.5 | Chute Construction | |
| | (a) Corners | One face of removable bolted flange connection |
| | (b) Joints Bolted | Flange joints of dust tight construction |
| | (c) Bolt size | Min. M-16 |
| | (d) Bolts spacing | Not more than 125 mm C/C |
| | (e) Fixing Arrangement | Bolts with plain spring washers |
| 2.2.0 | **Skirt Boards** | |
| 2.2.1 | Length | Entire feeding chute shall be extended minimum 3 m ahead of front edge of chute & 500 mm beyond rear edge of chute. |
| 2.2.2 | Height | Not less than 750 mm |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| 2.2.3 | Width | 2/3 of belt width |
| | Side plate | Min. 10 thk TISCRAL/equivalent |
| | Top cover | 6 mm thk M.S. |
| 2.3.0 | **Flap Gate** | |
| 2.3.1 | Type | Linear actuator operated, 2 position |
| 2.3.2 | Travel | 60 to 70 deg. (with limit switches on both sides). |
| 2.3.3 | Automatic operation | |
| | (i) Drive | Dust tight motor driven with suitable linkages |
| | (ii) Minimum Actuator Rating | 2500 kg with 1 m lever arm |
| | (iii) No. of Operation / Hr | 15 (with 10 consecutive switchings) |
| | (iv) Protection | Travel and Thrust dependent limit Switches. |
| 2.4.4 | Manual Operation | |
| | (a) Maximum effort | Convenient for single operator by declutchable hand wheel regardless of electrical power. |
| | (b) Minimum Hand wheel Diameter | 500 mm |
| 2.4.5 | Flap gate shaft | |
| | (i) Diameter minimum | 150 mm |
| | (ii) Material | EN-8 |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**DATA SHEET: DRIVE EQUIPMENT**

| | | | |
|---|---|---|---|
| 1.0.0 | **GENERAL** | | |
| 1.1.0 | Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors | | |
| | a) | For conveyors of belt conveyor systems | *****120% of actual power at drive motor output shaft at specified design capacity |
| | b) | Mobile trippers travel drive, mono-rail hoists (travel and hoisting), various pumps of DS systems, service water systems, cooling water system, potable water system and Ventilation Fans | *****110% of actual power requirement at drive motor output shaft at guaranteed (rated) capacity. |
| | *****The actual power at drive motor output shaft shall be calculated after considering all the losses of down the line equipment's of the drive train. | | |
| 2.0.0 | **DESIGN & CONSTRUCTION REQUIREMENT** | | |
| 2.1.0 | Gear Box | | TYPE |
| 2.1.1 | (a) | Below 40 kW | Helical, worm, bevel as per requirement without cooling coil |
| | (b) | Equal to and Above 40 kW | Helical / bevel helical without cooling coil |
| 2.1.2 | Service Factor | | As per accepted engineering practice / manufacturer's recommendations . |
| 2.1.3 | Ambient temperature for Thermal rating | | 50° C Minimum |
| 2.1.4 | Mounting | | On Machined/Ground Surfaces |
| 2.1.5 | Output Rating | | |
| | | | a) For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity} |
| | | | b) For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment } |
| | @ Service factor shall include all the components considered by the supplier and should be clearly indicated in manufacturer's gear box selection catalogues. | | |
| 2.1.6 | Duty | | 24 Hrs. Continuous |
| 2.1.7 | Rating | | Not less than motor name plate |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | | rating |
| 2.1.8 | Thermal Rating | Corresponding to 50 Deg ambient Temp and in any case shall not be less than motor rating. |
| 2.2.0 | Flexible Couplings | |
| 2.2.1 | Type | Geared coupling. |
| 2.2.2 | Rating | Not less than motor rating. |
| 2.3.0 | Fluid Couplings | For all motors having rating more than 40 kW. |
| 2.3.1 | Type | |
| | (a) L.T. Motors | Traction type |
| | (b) H.T. motors | Scoop tube type. |
| 2.3.2 | Rating | Not less than motor nameplate rating |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: LHP BUILDING** | |
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Under ground Junction tower (JT) | RCC |
| 1.2.0 | Over ground Junction tower | Steel Construction |
| 1.3.0 | Control/MCC rooms | RCC |
| 2.0.0 | **DESIGN & CONSTRUCTION REQUIREMENT** | |
| 2.1.0 | Junction tower & Crusher House | |
| 2.1.1 | Space requirement | To accommodate all equipments drive units, head/ tail ends of conveyors transfer chutes etc. and to provide adequate space for maintenance. |
| 2.1.2 | Floors | RCC construction with facility to wash the floors. Min. slope of 1:80 for floors in JTs shall be provided towards drain pipes. |
| 2.1.3 | Walls/Enclosure | Permanently colour coated cladding |
| 2.1.4 | Stairs | Steel construction with minimum 1000 mm width. |
| 2.1.5 | Doors & Windows | Steel construction |
| 2.1.6 | Monorails | Capacity as per equipment installed |
| 2.1.7 | Drainage | From each floor to drain pit suitable to handle limestone slurry. |
| 2.1.9 | Vertical bracing | Only along four sides. |
| 2.1.10 | Maintenance platform with handrails. | Chequered plate floors Min.1500 mm wide |
| 2.1.11 | Flooring | 50 mm thick metallic hardener like ironite floor finish. |
| 2.1.12 | Level of ground floor | 500 mm above ground level. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: TRAVELLING TRIPPER** | |
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Mobile Tripper | Motor driven type rail mounted. |
| 1.2.0 | Bunker Sealing Arrangement | Sealing belt type. |
| 2.0.0 | **DESIGN & CONSTRUCTION** | |
| 2.1.0 | Mobile Tripper | |
| 2.1.1 | Mounting | Rail mounted on rails (90 lbs/yard) with double flanged wheels. |
| 2.1.2 | Drive | Motor driven with suitable gearbox. Suitable for minimum 60 starts/hours. |
| 2.1.3 | Pulleys | |
| | (a) Head & Bend Pulleys | As specified elsewhere |
| 2.1.4 | Brakes | AC operated electro hydraulic thruster type on either side of tripper. |
| 2.1.5 | Clamps | Manual Rail clamps on either side of tripper. |
| 2.1.6 | Walkways | Both sides of tripper, 800 mm wide each |
| 2.2.0 | Bunker Sealing Arrangement | |
| 2.2.1 | Sealing Belt | |
| | (a) No. of plies | Minimum two |
| | (b) Top/Bottom cover Thickness | 5 mm/5 mm (Fire Resistant) |
| | (c) Width | At least 100 mm more than bunker slot. |
| 2.2.2 | Guide Rollers | As per requirements. |
| 2.2.3 | Bunker Slot | |
| | (a) Width | As per tender drawing |
| | (b) Cross bars over the slot opening | 12 mm x 50mm MS grating |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: DUST CONTROL & MISCELLANEOUS SYSTEM** | |
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Dust Control | Dust extraction system |
| 1.2.0 | Miscellaneous systems | Service water system, Potable water system, Cooling water system, sump pump and DE system pumps |
| 2.0.0 | **DESIGN REQUIREMENT** | |
| 2.1.2 | Pumps | 2x100% for water |
| 2.6.0 | **Service Water System** | |
| 2.6.1 | Water connections | |
| | (a) Conveyor Galleries | every 50 m |
| | (b) Junction towers | Min. 1 no. at every floor |
| 2.6.2 | Connection details | 32 NB plug valve |
| 2.6.3 | Hose pipes with hose reel | One in each building of 25 mtr. Length with nozzle |
| 2.7.0 | **Potable Water System** | |
| 2.7.1 | Pumps | 2 X 100% electric motor driven |
| 2.7.2 | Water connections | |
| | a) Junction towers | Minimum one (1) no. at each floor |
| | (b) Tripper floor | Minimum one (1) no. at every tripper bay. |
| 3.0.0 | **CONSTRUCTION REQUIREMENTS** | |
| 3.1.0 | **Water Supply Pumps for SW/PW/CW/DE** | |
| 3.1.1 | Casing | Axial or radially split with drain & vent connection |
| 3.1.2 | Impeller | One piece, keyed to shaft along with locking device |
| 3.1.3 | Shaft | Critical speed atleast 20% away from operating speed |
| 3.1.4 | Shaft sleeves | At bearings & stuffing boxes. |
| 3.1.5 | Bearings | Antifriction type |
| 3.1.6 | Wearing rings | Renewable type (preferable) |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| 3.1.7 | Pump speed | Below 1500 rpm for capacity more than 10 $m^3$/hr. |
| 3.1.8 | Head flow characteristics | Suitable for parallel operation. |
| 3.1.9 | Materials | |
| | (a) Casing | Cast Iron to IS:210, FG 260 |
| | (b) Impeller | Bronze conforming to Gr.I of IS:318 |
| | (c) Impeller Wearing ring | Bronze conforming to Gr.I of IS:318 |
| | (d) Casing Wearing ring | Bronze conforming to Gr.I of IS:318 |
| | (e) Shaft | Medium carbon steel |
| | (f) Shaft sleeve | Stainless steel conforming to AISI-416 hardened. |
| | (g) Gland packing | Impregnated teflon |
| 3.2.0 | **Sump Pumps** | |
| 3.2.1 | Type | Wet pit type vertical shaft |
| 3.2.2 | Duty | Capacity to handle large solids or unscreened liquid. |
| 3.2.3 | Materials | |
| | (a) Casing and rotor housing | Ni-Cast Iron (350 BHN) |
| | (b) Rotor | Ni-Cast Iron (350 BHN) |
| | (c) Shaft | Medium carbon steel |
| | (d) Gland | Bronze |
| | (e) Wearing rings | Stainless steel |
| | (f) Shaft enclosing tube | Carbon steel |
| 3.3.0 | **Pipings & Fittings** | |
| 3.3.1 | Joints | |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | (i) Pipe to pipe | |
| | Pipe size ≤ 50 NB | Socket welding/screwed |
| | Pipe size ≥ 65 NB | Butt welding |
| | (ii) Pipe to valves | |
| | Pipe size ≤ 50 NB | Screwed |
| | Pipe size ≥ 65 NB | Flanged |
| 3.3.2 | Isolation of flow | Plug / Gate / Sluice valves |
| 3.3.3 | Regulation of flow | Globe Valve |
| 3.3.4 | Valves | |
| | (i) Size ≥ 65 NB | Bolted bonnet outside screw rising type. |
| | (iii) Size ≤ 50 NB | Union bonnet with screwed ends for Globe valve & screwed ends for plug valve |
| 3.3.5 | Materials for Pipework | |
| | (a) For sizes 200 NB and Larger | ERW carbon steel pipes to API-5L-Gr.B/IS:3589 with minimum thickness 6.35 mm |
| | (b) For sizes 150 NB to 65 NB | ERW carbon steel black pipes to IS:1239 (Part-Heavy class). |
| | (c) For sizes below 65 NB | ERW carbon steel galvanized pipes to IS:1239 (Part-I) Heavy class. |
| 3.3.6 | Materials for Valves & Specialities | |
| | (a) Cast Iron Valves | 65 NB and above |
| | (i) Body and bonnet | Cast Iron to IS:210, Gr.FG-200 |
| | (ii) Disc for non- return | Cast Iron to IS:210, Gr.FG-200 valves |
| | (iii) Seating surfaces and rings | 13% chromium steel |
| | (iv) Hinge pin for non return valves | Stainless steel type AISI-316 |
| | (v) Stem for gate and globe valves | 13% chromium steel |
| | (vi) Back seat bush | 13% chromium steel |
| | (a) **Gun metal valves (50 NB & below and upto a working pressure of** | |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|

| | | |
|---|---|---|
| | **10 kg/cm2 (g))** | |
| (i) | Body | Gun metal to IS:318, Gr-2. |
| (ii) | Trim | Gun metal to IS:318, Gr-2. |
| (b) | **Duplex Strainer** | |
| (i) | Body | MS fabricated |
| (ii) | Strainer | Stainless steel type element AISI-316 |
| (c) | **Pressure Gauge/Switch (to be provided with isolating valves, gauge cock, snubber and syphon)** | |
| (i) | Dial size | 150 mm |
| (ii) | Accuracy | (+/-) 1% of range span |
| (iii) | Bourdon | AISI 316 SS |
| (iv) | Block | AISI 316 SS |
| (v) | Movement | AISI 316 SS |
| (vi) | Case and Bezel | Die cast Alum. Weather proof case stove enameled block with screwed type inner bezel of ABS plastic and glycerin filled. |
| (vii) | No. of contacts | 2 NO + 2 NC |
| (viii) | Type of contact | Adjustable throughout the range. |
| (ix) | Degree of protection | IP. 65 |
| (d) | **Solenoid valve (to be provided with isolating valve)** | |
| (i) | Type | 2/2 way Diaphragm type pilot operated |
| (ii) | Diaphragm | molded synthetic rubber |
| (iii) | Body | Forged brass / SS |
| (iv) | Pressure | 0.5 to 10 kg/cm² (g) |
| (v) | Protection Class | IP 65 |
| (e) | **Flow Switch (to be provided with isolating valves)** | |
| (i) | Body | Forged steel |

| | | | |
|---|---|---|---|
| | (ii) | Extension Rod/wire | SS-304 |
| | (iii) | Sleeve and Sleeve pipe | SS-304 |
| | (iv) | Cover | Die cast aluminum |
| | (v) | Max. working pressure | 10 kg/cm² (g) |
| | (vi) | Repeatability | ± 0.5% |
| | (vii) | No. of contacts | 2 NO + 2 NC |
| | (viii) | Type of contact | Adjustable throughout the range. |
| | (ix) | Protection class | IP – 65 |
| | (f) | **Level Switch** | |
| | (i) | Type | Displacer operated magnetic type |
| | (ii) | Displacer | SS – 316 |
| | (iii) | Wire rope | SS – 316 |
| | (iv) | Spring Housing Spring and sleeve pipe | SS – 316 |
| | (iv) | Cover | Cast Aluminum |
| | (v) | No. of Contacts | 2 NO + 2 NC |
| | (vi) | Type of Contact | Adjustable throughout the range. |
| | (viii) | Protection class | IP – 65 |
| | (g) | **Level gauges** | |
| | (i) | Type | Float type mechanical gauge with arrow scale |
| | (ii) | Accuracy | (+/-)1% of full scale range |
| | (iii) | Material of construction | |
| | (aa) | Float & Guide wire | 316 SS |
| | (bb) | Elbows | Suitable grade of SS |
| | (cc) | Housing | Mild Steel |
| | (dd) | Cable fastener | SS 304 |
| | (h) | **Dry Fog Dust Suppression Nozzles** | |
| | (i) | Type | Fogging, non-clogging type |

| | | |
|---|---|---|
| (ii) | Material | Stainless Steel |
| (iii) | Nozzle housing | To ensure protection of nozzle against damage. |

**(i) Y Strainer**

| | | |
|---|---|---|
| (a) | Body | SS 304 |
| (b) | Plug | SS 304 |
| (c) | Filter Element | SS 316, 60 mesh |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: VENTILATION SYSTEM** | |
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Mech. Ventilation System | To provide ventilation using fans for specified areas. |
| 1.1.1 | No. of air changes per hour | |
| | (a) For over ground building | Not less than 10 supply air changes |
| | (b) For under ground building | Not less than 15 supply air changes and 7 exhaust air changes |
| 1.1.2 | **Equipment** | |
| | (1) Underground tunnel | Centrifugal fans/Axial fans |
| | (2) All other places | Axial fans, roof ventilators |
| 1.3.0 | **Air-conditioning system** | |
| 1.3.1 | Temperature to be maintained | 24 ± 1 deg. C |
| 1.3.2 | Humidity to be maintained | 60 ± 5% relative humidity |
| 1.3.3 | Fresh Air intake | Minimum 1.5 air changes per hour. |
| 1.3.4 | Equipment | 2 x 100 % roof mounted package AC units along with ducting etc. and 2X100% window AC |
| 1.4.0 | **Outside Ambient Conditions** | As per weather data given in project synopsis |
| 2.0.0 | **DESIGN & CONSTRUCTION** | |
| 2.1.0 | **Axial Fans** | |
| 2.1.1 | Capacity | 10% more of actual requirement |
| 2.1.2 | Head | 20% more of actual requirement |
| 2.1.3 | Speed | |
| | (a) Impeller dia above 450 mm | Max. 960 rpm |
| | (b) Impeller dia less than or equal to 450 mm | Max. 1440 rpm |
| | (c) Critical speed | 25% above operating speed. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| 2.2.0 | **Centrifugal Fans** | |
| 2.2.1 | Capacity | 10% more of actual requirement |
| 2.2.2 | Head | 20% more than actual requirement |
| 2.2.3 | Speed | Max. 1500 rpm |
| 2.2.4 | Outdoor temperature | 50 deg.C. |
| 2.2.5 | Rating | Continuous |
| 2.3.0 | **Packaged Air-Conditioning Unit** | |
| 2.3.1 | Type | Roof top mounting |
| 2.3.2 | Service/application | Continuous, round the clock |
| 2.3.3 | Capacity | |
| | (i) TR | Suitable |
| | (ii) CFM | Suitable |
| 2.3.4 | Type of compressor | Hermetically sealed scroll compressor |
| 2.3.5 | Condenser | Air cooled type |
| 2.3.6 | Fan | Forward curved centrifugal fan |
| 2.3.7 | Filter | High efficiency filter |
| 2.3.8 | Cooling Coil | |
| | (a) Type | Direct Expansion |
| | (b) Material | Copper |
| | (c) Fins | Aluminum mechanically bonded. |
| 2.3.9 | Refrigerant Piping | Copper |
| 2.3.10 | Insulation for PAC parts | Expanded polyethylene of density at least 15 kg/m$^3$. |
| 2.4.0 | **Filters** | |
| 2.4.1. | Metallic Filters | |
| | (1) Max. air velocity | 2 m/s. |
| 2.4.2 | HDPE filters | |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | | |
|---|---|---|---|
| | (1) | Efficiency | 90% down to 5 microns |
| | (2) | Max. velocity | 2.5 m/s |
| | (3) | Testing | As per BS 2831 / Sqv. |
| 2.4.3 | High Efficiency Filter | | |
| | (1) | Efficiency | 99% down to 5 microns. |
| | (2) | Pr. drop across | 10 mm W.C. |
| | (3) | Testing | As per BS 2831 / Sqv. |
| **2.5.0** | Insulation for A/C Ducting Resin Bonded Mineral wool as per IS:8183 | | |
| 2.5.1 | Density | | 24 kg/m$^3$ |
| 2.5.2 | Thermal conductivity | | 0.49 mw/cm deg.C |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|

## DATA SHEET : BELT SCALE

| | | | |
|---|---|---|---|
| 1.0.0 | **GENERAL** | | |
| 1.1.0 | Ambient Temperature | | 50°C |
| 1.2.0 | Relative Humidity | | 100% |
| 2.0.0 | **DESIGN & CONSTRUCTION** | | |
| 2.1.0 | Type | | Electronic load cell type |
| 2.2.0 | Operation | | Microprocessor based fully automatic |
| 2.3.0 | No. of floating idlers | | Minimum four (4) |
| 2.4.0 | Load Cells | | |
| 2.4.1 | Type | | Strain gauge type hermetically sealed |
| 2.4.2 | Minimum Nos. | | Four (4) |
| 2.4.3 | Overload protection | | 100 % of rated belt scale capacity |
| 2.4.4 | Structural capacity | | 250 % of rated belt scale capacity |
| 2.5.0 | Flow Rate Indicator | | Electronic Digital Display Minimum 4 digits |
| 2.6.0 | Flow totalizer | | 8 digit display with reset facility. |
| 2.7.0 | Accuracy | | For entire range of 20% to 120% of rated capacity<br>Minimum $\pm$ 0.25% |
| 2.8.0 | Calibration | | |
| 2.8.1 | Automatic | | Zero & span calibration |
| 2.8.2 | Manual | | With test load chain |
| | (a) | Test load chain length | Two idler spaces more than weighing lengths |
| | (b) | Chain reel equipment | Complete with weight adding facility. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: ILMS/SM** | |
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Type | In line or suspended magnet type as specified. |
| 2.0.0 | **DESIGN & CONSTRUCTION** | |
| 2.1.0 | In-line Magnetic Separator / Suspended Magnet | |
| 2.1.1 | (a) Location of ILMS | Over discharge pulley. |
| | (b) Location of SM | Over Conveyor (as per tender drawing) |
| 2.1.2 | Force index (As defined earlier) | Minimum 100,000 |
| 2.1.3 | Strength of magnet at the specified mounting height | 1000 gauss. |
| 2.1.4 | Mounting height | Mounting height of In Line Magnetic Separator and Suspended Magnet shall be 450mm in the conveyors carrying uncrushed limestone & 400 mm in the conveyors carrying crushed limestone (between top of conveyor belt & surface of magnetic separator) |
| 2.1.5 | Magnetic Separator Belt | |
| | (i) Drive Unit | Adequately sized with 20% margin. |
| | (ii) Belting | Suitable to withstand high temp. & impact of tramp iron. (FR Grade) |
| | (iii) Discharge | Into Tramp iron chute. |
| 2.2.0 | Tramp Iron Items | |
| | (i) MS cube of 20 mm size | |
| | (ii) Brake shoe of Railway Wagon (Cast Iron 15 kg.) | |
| | (iii) MS plate of 250 x 250 x 100 mm size. | |
| | (iv) Shovel Teeth and spikes. | |
| | Material | Carbon Steel |
| | Size | Typical |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | (v) MS round bar of 50 kg with L/D ratio not exceeding 5. | |
| 2.3.0 | Control | |
| | Inline Magnetic Separator / Suspended Magnet | Local and remote |
| 2.4.0 | Electric Supply 415V, 3 phase, 50 Hz input | Silicon Rectifier units |
| 2.5.0 | Location of silicon rectifier unit | Nearby control/MCC room |
| 2.6.0 | Handling Arrangement for inline Magnetic separator/Suspended magnet | |
| | (a) Height adjustment | With turn buckle arrangement |
| | (b) Cross-travel | Electric Hoist operated cross travel facility. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: METAL DETECTOR** | |
| 1.0.0 | **GENERAL** | |
| 1.1.0 | **Type** | Coil type |
| 2.0.0 | **DESIGN & CONSTRUCTION** | |
| 2.1.0 | Sensitivity | - 35 mm Aluminum sphere below limestone for steel cord belting.<br>- 25 mm aluminum sphere below limestone for synthetic belting |
| 2.2.0 | Enclosure | Fiber glass |
| 2.3.0 | Control | Through local control panel. |
| 2.4.0 | Calibration | Provision for automatic static calibration with adjustable sensitivity. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET: LIMESTONE SAMPLING UNIT** | |
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Type | Automatic |
| 2.0.0 | **DESIGN & CONSTRUCTION** | |
| 2.1.0 | Codes & Standard | ASTM C-50 |
| 2.2.0 | Uncrushed feed limestone size | (-) 250 mm |
| 2.3.0 | Crushed feed limestone size | (-) 20 mm |
| 3.0.0 | **CHUTES** | |
| 3.3.1 | Min. angle | 60 deg |
| 3.3.2 | Cross section | Square/rectangular with rounded corners. |
| 3.3.3 | Joints | Bolted flanges with 6 mm thick standard grade neoprene gasket. |
| 4.0.0 | **CRUSHER** | |
| 4.4.1 | Uncrushed (as received) feed limestone size | (-)250 mm |
| 4.4.2 | Crushed (as fired) feed limestone size | (-) 20 mm |
| 4.4.3 | Output size | ASTM C-50 |
| 4.4.3 | Stages of size reduction | Single stage crushing |
| 5.0.0 | **BELT FEEDER** | |
| 5.5.1 | Belt | Flanged type, FR grade |
| 5.5.2 | Pulleys | Rubber lagged head pulley |
| 5.5.3 | Drive | Electric Motor |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | **DATA SHEET – PADDLE FEEDER** | |
| 1.00.00 | **GENERAL** | |
| 1.01.00 | Type of paddle feeder | Mobile, Rotary plough |
| 1.02.00 | Input limestone parameters | As described elsewhere in the specification |
| 1.03.00 | Location | Underground below ground hopper (Limestone storage shed) |
| 2.00.00 | **DESIGN & CONSTRUCTION** | |
| 2.01.00 | Paddle Wheel | |
| 2.01.01 | No. of paddle wheel vanes | Suitable |
| 2.01.02 | Material for Vane liners | TISCRAL / SAILHARD / LSLAS07 (Replaceable) |
| 2.02.00 | **Drive Arrangement** | |
| 2.02.01 | Paddle Wheel | Step less Hydraulic drive |
| 2.02.02 | Feeder Carriage & flexible coupling | Electric Motor with gear box<br>OR<br>Hydraulic Drive<br>OR<br>Electric geared Motor |
| 2.02.03 | Minimum No. of starts per hour for drive chain equipment | 15 Starts/hour (with minimum 10 consecutive starts) |
| 2.02.04 | Paddle wheel speeds | Step less variable |
| 2.03.00 | **Paddle Feeder Rails** | |
| 2.03.01 | Size | 90 lb/yard |
| 2.03.02 | Support Arrangement | To be mounted on supporting structure of conveyors with continuous support below rail. |
| 2.04.00 | **Feeder Carriage wheels** | |
| | (i) Nos. | Suitable |
| | (ii) Type | Double Flange |
| | (iii) Bearings | Sealed type |
| 2.05.00 | Anti Collision Device | Mechanical and Infra red type |
| 2.06.00 | Cable Tray Height & width | Min. 300 mm above floor & 300 mm wide all along the length of storage shed hopper on both sides. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| 2.07.00 | Control | Local |
| 2.07.01 | **Location of Control Panel** | On the feeder carriage |
| 2.08.00 | Idlers for conveyor Belt | As per relevant Sub-section for Belt conveyor system |
| 2.08.01 | Spacing of carrying idlers in the loading zone of paddle feeders | 600 mm (maximum) |
| 2.09.00 | Chute work and hopper | 20 mm thick TISCRAL / SAILHARD / LSLAS07 |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|

**DATA SHEET – LIMESTONE CRUSHER**

| | | |
|---|---|---|
| 1.0.0 | **GENERAL** | |
| 1.1.0 | Type | Hammer Mill type crusher |
| 1.3.0 | Material to handle | Limestone |
| 1.4.0 | Feed Size | (-) 250 mm, occasionally 1-2% of 400mm size |
| 1.5.0 | Product size | To suit limestone pulverizer and system , minimum 90% |
| 1.6.0 | Input limestone parameters | As specified elsewhere |
| 1.7.0 | Limestone feeding arrangement | Through vibrating screen feeder (However the crusher hall be designed/sized considering zero passage of limestone through screen). |
| 2.0.0 | **DESIGN AND CONSTRUCTION** | |
| 2.1.0 | Drive arrangement | Electric motor, scoop type hydraulic coupling, gearbox. |
| 2.2.0 | Rotor Balancing | Static |
| 2.3.0 | Type of sealing | Labyrinth, dust tight arrangement |
| 2.4.0 | Type of bearings | Spherical roller |
| 2.5.0 | Lubrication | Manual through grease gun<br><br>OR<br><br>with recommended grade of oil in which case the Plummer block shall be designed with oil filling, oil draining and visual oil checking facilities |
| 2.6.0 | Tramp collection | Required |
| 2.7.0 | Output size adjustment facility | Required |
| 2.8.0 | Top cover of crushers | Hydraulically operated |
| 3.0.0 | **MATERIAL OF CONSTRUCTION** | |
| 3.1.0 | Rotor Shaft | Forged steel |
| 3.2.0 | Hammer heads | Wear resistant cast alloy steel |
| 3.3.0 | Hammer arm | Forged alloy steel |
| 3.4.0 | Housing/frame | Steel as per IS:2062 |
| 3.5.0 | Breaking blocks | Cast steel/MS fabricated |
| 3.6.0 | Liners | |
| | (a) Material | Suitable for duty requirement |
| | (b) thickness | As required |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **3.0.00** | **OPERATION AND CONTROLS** |
| 3.2.00 | 3.01.00 This section is intended to cover control/instrumentation and operational philosophy as specified hereinafter complete in all respects, required for Lime stone ~~and Gypsum~~ handling facilities under subject package. |
| 3.3.00 | **General Requirements**<br><br>The instruments and controls to be furnished and erected under this specification are as required for safe and satisfactory operation of the Lime Handling System, as outlined under mechanical section and as specified elsewhere in the specification. For the equipment and materials procured by the Contractor from his sub-vendors, the Contractor shall study the specification, safety requirements, interface drawings for such equipment and material in detail and shall coordinate his work with his sub vendors and FGD DDCMIS system and supply instrumentation and control to suit the actual Lime stone and Gypsum Handling equipment. |
| 3.3.1 | **Standards / Codes**<br><br>All construction, installation, workmanship, design & equipment shall conform to acts, rules & regulations of the jurisdiction within which the project is to be located, and to the current edition of the following or equivalent standards or codes, in so far as they apply :<br><br>American Iron & Steel Institute (AISI)<br><br>American Society for Mech. Engineers (ASME)<br><br>American Society for Testing & Materials (ASTM)<br><br>American Wire Gauge (AWG)<br><br>Institute of Electrical & Electronic Engrs. (IEEE)<br><br>Instrument society of America (ISA)<br><br>National Electrical Code (NEC)<br><br>National Electrical Manufacturers Association (NEMA)<br><br>United States of America standards (USAS)<br><br>Bureau of Indian Standards (BIS)<br><br>Conveyor Equipment Manufacturers Association (CEMA) |
| 3.03.00 | This Sub-section shall be read in conjunction with Electrical Sub-sections. |
| **3.04.00** | **General Construction and Design** |
| **3.04.01** | **General Construction**<br><br>Control desks/panels and annunciation system shall be as per the requirement of electrical Section. Annunciations, indications, electrical meters and instrumentation shall be provided as specified. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| **3.04.02** | **Design**<br><br>The complete lime handling plant shall be controlled from FGD DDCMIS system as detailed elsewhere. Also refer other clauses of this chapter.<br><br>The Contractor shall provide a comprehensive control indication and annunciation scheme. Contractor shall furnish block diagram and write-up on the scheme proposed. The final scheme will be approved by the Employer. In general, interlocking shall be achieved through feed-back signals from field equipment. Comprehensive Annunciation and Indication scheme shall be provided such that, it will be possible for the operator to locate and identify the fault from the face of DDCMIS/LVS/Control-Panel/ TFT itself. The scheme shall include the basic remote control instrumentation, indication and annunciation requirements as per various technical specification requirements.<br><br>However, the Contractor may offer any alternative proposal which he considers to be equal, superior to the scheme as described in subsequent clauses below for achieving reliable and trouble free operation of the plant, for consideration of the employer. |
| **4.00.00** | **OPERATION AND CONTROL PHILOSOPHY**<br>The lime handling system shall be controlled from the following control points. |
| 4.01.00 | **Coal Handling Plant Main Control Room**<br><br>Overall, operation of the following equipment of Lime Handling Plant shall be controlled from the main FGD control room through FGD DDCMIS being provided by the Contractor.<br><br>(a.) Conveyors, feeders, flap gates, R & P gates, crushers, hydraulic scoop couplings.<br><br>(b.) Complete Dust Suppression system, service water system, cooling water system & potable water system.<br><br>(c.) Ventilation system (group/individual control as required).<br><br>(d.) In line Magnetic separators and Suspended Magnet (ON/OFF control with indication).<br><br>(e.) Metal Detectors (ON/OFF control with indication).<br><br>(f.) Lime Sampling Units.<br><br>(g.) Belt weigher (ON/OFF control with indication)<br><br>(h.) Mobile trippers over bunkers/ storage shed (tripper position indications).<br><br>(j) Paddle feeder (running status with stop facilities). |
| 4.02.00 | **Local Control Panels**<br><br>**Local control stations for following equipment's shall be provided**<br><br>(a) Paddle feeders along with its dust extraction system<br><br>(b) Mobile trippers over bunkers/ storage shed<br><br>(c) Belt Weighers<br><br>(d) Metal detectors |

(e) Electric hoist - wall mounted control box with pendent push button controls.

(f) In line magnetic separators

(g) Suspended Magnet

(h) Sump Pump

(i) Hydraulic scoop coupling.

(j) Lime Sampling Sytem:- Complete PLC along with interface with FGD DDCMIS

All the above local control panels shall be accessible and located near their respective equipment and shall be complete with all the required controls, interlocks, annunciation's etc. However, for items (j.), above, controls shall be through contractor's PLC. Further, necessary controls, indications and annunciations for all the above equipment shall also be provided at main FGD Control Room as described under relevant clause.

4.03.01 **System Operation**

4.03.01 Lime conveying facilities under subject package shall be operated in association with a coal handling plant being provided by contractor separately.

The lime handling plant being provided by bidder envisages control of complete lime handling system including facilities under subject package by DDCMIS.

Envisaged Operation philosophy of the plant, in general, shall be as elaborated below:

(a.) Lime flow path selection shall be done from CRT/Keyboard to select any one of the following conveying paths.

a. Track hopper to Limestone storage shed

b. Wagon Tippler to Limestone storage shed

c. Limestone storage shed to Limestone bunker

d. Combination of above

The lime handling system operator will select any one of the above paths from OWS located on the main control desk. The flow stream path is then selected by positioning different flap gates/ movable discharge pulley at desired positions by means of keyboard available at the central control desk. Once the system is in the operation, the gates/ movable discharge pulley can not be moved from their positions and path. Flap gates which do not come in the stream in which coal flow is taking place, can be operated at any time. However, for the flap gates in Limestone bunker area conveyors, it shall be possible to change flap gate position while the conveyor is in operation and feeding coal using interlock bypass facility, provided that sequential permissive are available.

The Control system will be designed for "Auto" & "Manual" operation of the conveyors in the selected path. Auto/Manual Selection shall be done from keyboard.

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**Auto Mode** : In the “Auto” mode, the conveyors and related equipment will start sequentially when the “System Start” is activated. During stopping, when the “System Stop” is activated, all conveyors will also stop sequentially (in the reverse sequence) allowing time delays for clearing the belts.

**Manual Mode** : In Manual Mode, the operator will start the conveyor system, in the same sequence as in Auto mode from keyboard. The operator will also stop the conveyor system, by pressing "System stop" or individual “Stop” push buttons/command from keyboard in the reverse sequence.

During “Sequence Start” in both Auto and Manual modes, first the required number of hooters (3 phase induction motor type) will be energized simultaneously for a preset time of 1 minute or so (adjustable at site) as per the program. After the preset time, the hooters will stop and a preset time of two minutes (adjustable at site) as per program will be allowed for the movement of the personnel and for the permissive of the conveyor system operation. This condition will be indicated on the panel by glowing of lamp “Lime Handling Sequence Start”. The starting permissive will be available for a period of 5 minutes (Pre-programmed and adjustable in the field). In the event the last conveyor / equipment is not started within this preset time of 5 minutes, the start command for equipment not started will be withdrawn. The system cannot be started again unless the “Sequence Start” push button is again pressed and the hooters sound again, as described before. Those conveyors and equipment, which have already started, will continue to run.

The status indication in the graphic display against all conveyors and equipment in the selected path/stream will start slow flickering. However, all status indications against all flap gates / movable discharge pulley in the selected path will glow steadily. Therefore, from the selected flow stream path of the flap gates / movable discharge pulley, the operator will come to know the conveyors and equipment to be started for the selected path/stream. After a conveyor/equipment is started, the status indications against that conveyor / equipment will change to steady glow indicating that it is running. **Separate color scheme shall be provided to all common conveyors and equipment, to distinguish handling of Lime and Coal while conveying**

Graphic display status indicators associated with a particular motor/equipment shall flicker fast in case of fault / trip.

In addition, emergency stop push button on the control desk for immediate shut down of complete plant shall be provided.

For changeover of feed from one row of Bunkers to another row of Bunkers without stopping of the LHP, provision shall be made for interlock bypass on the control desk for flap gates of all conveyors in Boiler area for a preset period. If the changeover, in above specified time, is not completed then the entire LHP shall stop.

(i) Lamp test facility will be provided for the annunciation and mimic lamps.

4.06.00 **Conveyor System**

(a) Normally the movement of the paddle feeders feeding Lime from the Limestone shed to the conveyor shall be controlled from the paddle feeder itself based on instructions from main control room.

(b) The paddle feeder carriages shall move continuously to and fro along their tracks. Suitable limit switches and anti-collision devices (both mechanical limit switch operated and infra- red type) shall be provided to enable them to change direction of movement as soon as they come within a specified distance at the end of travel in one direction.

(c) The operation and stoppage of the paddle feeders shall be signaled in the main control room of the Lime handling plant. It shall be possible to stop the paddle feeder from main control room. It shall be possible to stop the conveyor taking feed from paddle feeder from respective paddle feeder.

(d) Each conveyor shall be protected against damage to the edge of the belt due to excessive sideways movement by providing an adequate number of belt sway switches. In addition, each conveyor shall be provided with one (1) No. speed detection device (zero speed switch). The zero speed switches shall be designed to sense belt speed. In case of speed of belt goes below 85% of rated speed, it shall trip the conveyor.

(e) All the conveyors shall be protected from reverse running due to power failure by providing mechanical or electrical locking system.

(f) The starting sequence of the conveyors shall follow a direction opposite to that of flow of material i.e. :

(1.) In case of direct conveying of lime to limestone bunkers, start from lime bunker conveyor and end up with reclaim conveyors below track hopper/Wagon Tippler .

(2.) In case of stacking of lime in stock yard, start from yard conveyor and end up with reclaim conveyors below track hopper/Wagon Tippler.

(3.) In case of reclamation of lime from stock yard, start from bunker conveyors and end up with yard conveyor alongwith Travelling tripper.

(4) The starting of mobile trippers shall be interlocked with operation of the bunker bay conveyors.

(g) Any individual equipment (belt conveyor etc.) should not be allowed to start unless the equipment immediately following the same in the direction of flow of material is already in operation.

(h) Stop/tripping of any equipment from running condition shall trip all preceding equipment in the system, except crushers but shall not effect succeeding ones which shall continue to operate.

(i) Adequate number of pull-cord switches shall be provided at suitable intervals along the length of each belt conveyor, which shall enable the respective conveyor to be stopped immediately. Each pull chord switch shall be identified by a specific number on HMI in the main control room. Each belt sway switch shall also be identified by a specific number on HMI in control room.

(j) Means shall be provided to pre-warn personnel working nearby when starting any conveyor and mobile tripper.

(k) Interlocking of various conveyors shall be achieved with Flap Gate, discharge pulleys, limit switches and zero speed switches.

(l) Suitable indication for paddle wheel rpm shall be provided on the local panels. Manual facility to control the cutting rate of paddle feeder shall also be provided.

(m) Motors shall start only when the brake/rail clamp if-provided, is in “not applied’ ‘condition. This signal shall be obtained from limit switch provided for that purpose.

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(n) Lime stone crusher shall be provided with speed and vibration monitoring instruments. crusher shall trip in case speed/ vibration is going beyond tolerable limits of design. Temperature sensing devices shall be installed on all bearings of each of the ring granulator to trip the ring granulator in case of temperature goes beyond limit. Audio-visual annunciation shall be provided in main control room and locally also.

(o) Once a conveyor trips, flap gate directing coal from this conveyor shall change over its position with a time delay and shall come back to the original position again. This is to prevent jamming of gate.

(p) Tripping of the respective conveyor shall be provided in case any of paddle feeders and mobile trippers starts running along with conveyor belt at speed higher than their rated speed by providing an over speed sensing device on the equipment.

(q) It shall be possible to trip bunker conveyor from mobile tripper Where ever scoop type coupling provided for HT motors, the coasting time of respective conveyor, thruster brake, actuator selection and the chute size shall be so selected such that there is no spillage of coal from any down stream conveyors during next start.

(r) Wherever the conveyor is provided with the movable discharge pulleys in place of flap gates, the starting of the conveyor will be interlocked with the position of the movable discharge pulley.

4.07.00 **Interlocking**

(a.) The following conveyors / equipment will come under interlock scheme :-

(1) All conveyors

(2) All flap gates

(3) Mobile Trippers

(4) Rack & Pinion Gates

(5) Metal detectors

(6) Magnetic Separators and suspended Magnet

(7) Crushers

(8) Paddle Feeders

(9) Belt scale

(b.) The following equipment will not come under interlock of the conveyor scheme.

(1.) All dust extraction systems & service water system.

(2.) Ventilation systems

(c.) All conveyors and equipment will have local push button stations each consisting of :

(1.) Pos - I, Pos - II & stop button for flap gate.

(2.) Emergency stop push button (Red) for other equipment

(d.) Belt scale shall be started when relevant conveyors are started

(e.) The dust extraction systems will be energized as soon as the conveyors are energized.

(f.) Lime handling plant shall be tripped in case of detection of fire.

(g.) Interlock for H.T. Motor :

H.T. motors used will continue to run on no load by disengaging the fluid coupling in case of failure of any process interlock. The H.T. motors will however be tripped in case of any motor fault like O/L, high motor winding temperature etc. In addition, in case of normal stop command, after running of the system, motors will stop.

**(h.)** The following are the various safety interlocks for the conveyors and other equipment. This list is indicative only and the Contractor shall develop a comprehensive interlocking scheme.

**Conveyors**

a) Pull - Chord switch - not operated

b) Belt sway switch - not operated

c) Under speed switch - closed at 90% speed of the conveyor within designed accelerating time.

d) Motor protection - not tripped

e) Local stop PB – reset

f) Chute Block switch - not operated.

g) Brakes for conveyor – not operated.

h) Trip circuits healthy.

i) Temp. of fluid coupling oil - not high

**Paddle Feeders**

a). Motor O/L - not tripped

b). Local E-Stop PB - reset

c). Stop PB in main FGD control room - reset

d). All Limit Switches – reset

e). Overspeed limit switch – not tripped

**Travelling Tripper :**

a) Stop PB in Local control station - reset

b) Motor O/L not tripped.

c) Over Travel Limit switches - not tripped.

**Magnetic Separators / Metal Detectors / Suspended Magnets**

a) O/L / fault relay - not tripped.

b) Stop PB (Local & Remote) reset.

c) Metal detector reset

d) Oil temperature - not high

**Flap Gates/ R & P Gates**

a) End of travel limit switches - reset.

b) Torque limit switches - reset.

c) Local stop - reset.

**Crusher**

a) Zero speed - not operated

b) Temp. of fluid coupling oil - not high.

c) Local stop push button reset.

d) Temperature of bearings – not high.

e) Cooling water flow switch – reset

Motor O/L – not tripped

Local E-Stop PB-reset

Stop PB in main FGD Control Room reset.

All limit switches - reset

All limit Switches – not tripped.

Apron feeder

Motor O/L – not tripped.

Local stop PB – reset

4.07.01 The lists of indications and audio-visual annunciation given in subsequent clauses are indicative only and the same shall be finalised during detail engineering.

4.07.02 Status indications in Large Video Screen

Following individual status indications shall be provided in LVS with individual ON/OFF/TRIP indications on CRT.

(a.) Conveyor 'ON'

(b.) Flap Gate Rack and Pinion.

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(c.) Belt scale flow rate indication and totalizer.

(d.) Belt sway switch operated for each conveyor (individual switch indication on CRT).

(e.) Pull cord switch operated for each conveyor (Individual switches indication on CRT).

(f.) Zero speed switch operated for each conveyor

(g.) Paddle Feeder ''ON

(h.) Travelling tripper position."

(i.) Crusher ON

(j.) MD/ ILMS/ SM/ LSU ON

(k.) DE/ SW/PW/CW/Vent ON (System wise)

(l.) Unit wise MW indication, total lime flow & Bunker level.

(m.) Further Mimic lamps for HT and LT SLDs shall be provided on the control desk.

4.08.00 **Annunciation System:**

DDCMIS/Control desk shall be provided with adequate number of facia type annunciation windows operating through DDCMIS for the following audio-visual fault annunciation purposes. Wherever group annunciation is provided, alarm status of individual equipment shall be provided on OWS.

(a) 3.3 kV Breaker Trip (Group wise for each board)

(b) 415 V MCC Breaker Trip (MCC wise)

(c) Bus under voltage for each LT MCC & HT switchgear buses.

(d) Following group wise annunciation shall be provided for transformers :

- (1.) Buchholz alarm
- (2.) Winding/oil temperature high alarm
- (3.) Oil level low alarm
- (4.) Buchholz trip
- (5.) Winding/oil temperature high trip

(e) A.C Control Supply failure.

(f) D.C. Control Supply failure.

(g) Annunciation supply failure.

(h) Both CPU fail

(i) Stand by CPU in service

(j) H.T. motor overload alarm (individual)

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(k) HT motor bearing/ winding temp. high alarm (for each) and trip (for each)

(l) HT motor trip on electrical fault (for each)

(m) LT motor overload tripped (for each).

(n) Belt sway switch operated (for each)

(o) Pull cord switch operated (for each)

(p) Zero speed switch operated. (for each)

(q) Chute plugged (for each)

(r) Paddle feeder over speed tripped (group)

(s) Tripper over speed tripped (for each)

(t) Magnetic separator fault and cleaning belt trip.

(u) (i) Metal Detector fault (for each)

(ii) Metal detected / MD not reset (for each)

(v) Belt Scale fault (for each)

(w) Sampling system faults and trips (for each)

(x) Crusher low speed & crusher bearing temperature – high.

(y) Water level low in tanks (for each)

(z) Oil temperature of fluid coupling high

(aa) Dust Extraction/service water system faults and trips (system wise)

(bb) 20% spare window

For identification of the fault for a particular conveyor or equipment, status indication against that conveyor / equipment in the mimic will start fast flickering and the annunciation window will be blinking against that particular fault. In addition, a buzzer (alarm) will start sounding. After acknowledgement of the fault, the buzzer will stop, but the fast flickering on the mimic and the steady glow on the annunciation window will continue until the fault is cleared and the Reset push button is pressed. When the fault is cleared and the Reset push button is pressed, the status indication of that conveyor / equipment on the mimic will start slow blinking if it is on selected path otherwise it will go off and the steady glow in the annunciation window will go off. However, pressing of the Reset push button before clearance of the fault, will have no effect on the lamps.

At the time of a fault, the faulty conveyor / equipment, as well as the preceding conveyors / equipment in the interlock sequence, will stop except H.T. motors for which only scoop coupling will be disengaged and motor will continue to run for process fault. In case of motor fault, H.T. motor will trip but the succeeding conveyors / equipment will continue to run. The status indication against the preceding conveyors / equipment will start slow blinking while the faulty conveyor / equipment will be fast blinking.

Start command shall not be initiated unless reset button in pressed after clearance of fault.

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The sequence of operation of the annunciation system shall be as follows :-

| CONDITION | | | STATUS |
|---|---|---|---|
| Normal : | Ann. Window | : | Off. |
| | Status indication | : | Steady glow |
| | Buzzer | : | Off. |
| Fault : | Ann. Window | : | Blinking. |
| | Status indication | : | Fast blinking |
| | Buzzer | : | Sounding. |
| Press Accept. PB. | Ann. Window | : | Steady glow. |
| | Status indication | : | Fast blinking |
| | Buzzer | : | Off. |
| Press Reset PB (When | Ann. Window | : | Off. |
| fault is cleared): | Status indication | : | **i)** Steady blinking (if on selected path) |
| | | | **ii)** Off (if not on selected path) |
| | Buzzer. | : | Off. |

4.09.00 **Dust Extraction System**

Complete interlock, protection, annunciation for Dust Extraction System to be provided by the contractor and the same shall be approved by Employer during detail engineering.

4.10.00 **Metal detectors**

(a) It shall be possible to start the conveyors only after energizing the metal detector and 'Metal detector reset' condition. Once the metal is detected, the corresponding conveyor shall trip.

It shall be possible to restart the conveyors, after local resetting of metal detector and putting back the marker bag in position. Metal detector ON/OFF push buttons shall be provided in main control room also.

(b) In case of tripping of conveyor system, metal-detector shall get de-energized after a time lag.

(c) Following individual indications shall be provided on local control panel.

(1) Metal detector 'ON'

(2) Metal detected

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| (3) | Metal detector 'reset'. |
| (4) | Metal detector faulty. |
| 4.11.00 | **Sump Pumps**<br><br>(a) Sump Pumps shall start and stop by the level switches in the sump automatically. Further manual override start / stop push button shall be provided locally on ground level.<br><br>(b) Any of the pumps can be selected as auto-standby.<br><br>(c) If the sump level continues to be high even after the first pump is under operation second pump shall start automatically.<br><br>(d) The following indications for sump pumps shall be provided on local Control Panel.<br><br>(1.) Water level high<br><br>(2.) Motor ON/OFF/TRIP. |
| 4.12.00 | **Lime Sampling system**<br><br>(a) Lime Sampling Unit shall be controlled through PLC as per standard and proven practices of LSU equipment / LHP supplier, which will be located nearest MCC. Controls and interlocks for proper material flow shall be provided similar to conveyor system. Suitable Mimic shall be provided in the PLC.<br><br>(b) Lime Sampling Unit shall be controlled through main FGD DDCMIS. Controls and interlocks for proper material flow shall be provided similar to conveyor system. Mimic shall be provided in the Operator Work Station (OWS) at main FGD control room.<br><br>(c) Only one start/stop push button along with selector switches for various modes of operation of Lime sampling system shall be provided for automatic operation of complete lime sampling system. This control facility shall be provided at main FGD control desk as well as locally. In any case, local push button stations shall be provided for all individual equipment of lime sampling system near the equipment.<br><br>(d) All necessary automatic controls shall be provided for meeting the requirements of ASTM-D-2234 or ASTM-C-50.<br><br>(e) Following indications shall be provided on local control panel<br><br>(1.) System ON/OFF/TRIP<br><br>(2.) Primary cutter stuck up between parking positions.<br><br>(f) In case of primary cutter getting stuck between parking positions, preceding conveyor shall trip and annunciation shall appear at Main FGD Control room.<br><br>(f) There shall be protection in the primary coal sampler to trip the conveyor belt in case primary sampler falls on running conveyor due to coupling failure etc.<br><br>(g) Necessary interface signals e.g. LSU system status, cutter stuck etc shall be provided at main FGD control room. |

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**4.13.00 Paddle Feeders**

Paddle feeders shall be controlled from the local control panel suitably mounted on the unit. Requirement of operation as described else where in the specification shall be complied with. Following indications shall also be provided on the local control panel:

(a.) Motor ON/OFF

(b.) Motor O/L protection operated

(c.) Brakes applied (if provided)

(d.) "Digital pressure indications of Hydraulic Power pack including those of hydraulic pump discharge, return (leakage) traverse pump discharge (forward and reverse) oil line."

(e.) Coal flow rate

Main Hydraulic pressure of paddle feeder wheel drive system to be reduced to minimum through its control circuit during each tripping of main drive motor.

4.14.00 **Travelling Trippers**

(a) Mobile tripper unit shall be locally controlled from the operating platform suitably located with the unit as per instructions given from main FGD control room.

(b) End travel limit switches shall also be provided.

(c) Travel drive motor shall start only when brake and rail clamps are in disengaged condition.

(d) It shall be possible to trip the bunker Conveyors from tripper.

(e) When the last bunker is full, it shall not be possible to change over the tripper flap gate from bunker feeding position to last bunker feeding position.

(f) As soon as the bunker conveyor trips, tripper flap gate shall change over its position after a time lag.

(g) Two nos. emergency stop button one on each side shall be provided on tripper to stop the machine at any position. The control unit on tripper shall be provided with start / stop push button and indication lamp for travel / gate. The tripper brakes and rail clamps shall be energised (and released) when the tripper motors are ON and the brakes will be applied when the travel motors are OFF. Two travel limit switches shall be provided at either end of tripper carriage for limiting the travel drive between two ends of the track. The first one shall be normal limit and the second one for over travel limit. In addition to above, position indication for bunker position of tripper will be provided in Main control room. Necessary position encoders/limit switches shall be provided.

(h) Following individual indications shall be provided on local control panel

(1.) Motor ON/OFF/TRIP

(2.) Brakes applied

(3.) Rail clamps applied

(4.) Flap gate position

(i) Indication of tripper flap gate positions shall be given in the main FGD control room.

(j) Chute blockage switch shall be provided at each leg of chute and shall trip the tripper conveyor in case of blockage.

4.15.00 **Flap Gates/ R&P Gates**

All Flap Gates/ R&P Gates shall be motorised with remote controlled from the main control desk. Their position shall be indicated on the mimic of main control room.

4.16.00 **Belt Weighers**

Each belt scale shall give output to DDCMIS for display of flow rate indicator and totalizer on TFT and print out at main FGD control room. Each belt scale shall also have rate flow indicator and totaliser mounted near the unit.

4.17.00 **Magnetic separator / Suspended Magnet**

It shall be possible to start the conveyor only after energising the magnet of ILMS or SM. Further, if conveyor system trips magnetic separators shall get de-energised after a time lag and suspended magnet will remain energised and can be de-energised locally. Also if drive motor of cleated belt of ILMS trips, magnetic separator shall not get de-energised, but conveyor system shall trip and audio-visual annunciation shall appear at main FGD control room.

Following individual indications shall be provided on local control panel

(a.) Magnetic separator ON.

(b.) Incoming supply ON

(c.) 'Under current relay' operated

(d.) Cleated belt motor ON/OFF/TRIP

(e.) Oil temperature high

4.18.00 **Service water, Cooling Water and potable water pumps**

(a) These pumps shall be started from main FGD control room

(b) Pump shall trip in case of low water level in tank.

(c)Following individual inputs shall also be provided to DDCMIS system for alarms/indications :

(1.) Motor ON/OFF/TRIP

(2.) Discharge water pressure low

(3.) Water level low in tank

(4) Water level high in tank

Contractor shall provide a comprehensive interlock and protection scheme and include a block logic diagram and write up on the scheme proposed. The final scheme shall be subject to approval of Employer. Sequential interlocking as applicable shall be provided. This shall be a part of main interlock scheme /writeup for the entire Lime Handling Plant.

**4.21.00** **Summary of control philosophy**

Contractor shall furnish summary of control philosophy indicating permissive, trip and interlock conditions for each drive/equipment. It shall clearly list all permissive conditions (conditions required to start the drive), all the trip/protection conditions and each auto start/open and auto stop/close condition for each drive/equipment.

The sequential start-up and shut-down steps for a group of drive/equipments shall also be described clearly.

The above summary conditions shall be comprehensive to include all process conditions and shall be elaborated in clear and unambiguous way, and shall include tag numbers of devices and equipments.

A centralized main FGD control room (DDCIMS based) shall be provided to control and monitor the operations of the Lime handling system and Gypsum handling plant.

4.22.00 **Logic Diagram**

The contractor shall furnish comprehensive logic diagram showing all interlock, protection, sequence and alarm requirements of complete system to the employer during detail engineering stage. In this logic diagram, tag number corresponding to I/O list and drive list shall be clearly indicated. The format of this logic diagram shall be informed by employer during detail engineering. The recommended logic and write-up shall match fully.

# SUB-SECTION-I-M7

# ZERO LIQUID DISCHARGE SYSTEM

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| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

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**1.00.00 CODES AND STANDARDS**

1.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment/plant/system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

(a.) Bureau of Indian Standards (BIS)
(b.) Indian Boiler Regulations (IBR)
(c.) Regulations of the Ministry of Environment & Forest (MoEF),
(d.) State Pollution Control Board.
(e.) Explosive Rules, 1983
(f.) Static and Mobile Pressure Vessels (Unified) Rules, 1981
(g.) Owner's Safety Policy
(h.) Any other statutory codes/standards/regulations, as may be applicable.

1.02.00 Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions, of the codes and standards given below shall also apply:

(a.) British Standards (BS)
(b.) Japanese Industrial Standards (JIS)
(c.) American National Standards Institute (ANSI)
(d.) American Society of Testing and Materials (ASTM)
(e.) American Society of Mechanical Engineers (ASME)
(f.) American Petroleum Institute (API)
(g.) Standards of the Hydraulic Institute, U.S.A.
(h.) International Organization for Standardization (ISO)
(i.) Tubular Exchanger Manufacturer's Association (TEMA)
(j.) American Welding Society (AWS)
(k.) Cooling Tower Institute (CTI)
(l.) National Electrical Manufacturers Association (NEMA)
(m.) National Fire Protection Association (NFPA)
(n.) International Electro-Technical Commission (IEC)
(o.) Expansion Joint Manufacturers Association (EJMA)
(p.) Heat Exchange Institute (HEI)
(q.) IEEE standard

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(r.) JEC standard
(s.) American Gear Manufacturers Association (AGMA).
(t.) American Institute of Steel Construction (AISC).
(u.) American Iron and Steel Institute (AISI).
(v.) American National Standards Institute (ANSI).
(w.) American Society for Testing and Materials (ASTM).
(x.) American Society of Mechanical Engineers (ASME).
(y.) B31.1. Power Piping Code.
(z.) American Water Works Association (AWWA).
(aa.) D1.1 Structural Welding Code.
(bb.) Anti-Friction Bearing Manufacturers' Association (AFBMA).
(cc.) Hydraulic Institute Standards (HIS).
(dd.) Institute of Electrical and Electronic Engineers (IEEE).
(ee.) Instrument Systems and Automation Society (ISA).
(ff.) Insulated Cable Engineering Association (IPCEA).
(gg.) Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
a. SP58 - Pipe Hangers and Supports - Materials Design and Manufacture.
b. SP69 - Pipe Hangers and Supports - Selection and Application.
c.SP89 – Pipe Hangers and Supports – Fabrication and Installation Practices
d. SP90 – Guidelines on Terminology for Pipe Hangers and Supports
(hh.) National Electrical Code (NEC).
(ii.) National Electrical Safety Code (NESC).
(jj.) National Institute of Safety and Health (NIOSH).
(kk.) Occupation Safety and Health Administration (OSHA).
(ll.) Pipe Fabricators Institute (PFI).
(mm.) Rubber Manufacturers Association (RMA).
(nn.) Steel Structures Painting Council (SSPC).
(oo.) Tubular Exchanger Manufacturer's Association (TEMA).

1.03.00 Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Owner's approval, for which the Bidder shall furnish, along with the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations

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| | and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English. |
| 1.04.00 | National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. In addition, these standards shall be referred for the design of machine foundations, wherever specifically mentioned in the specifications. However, for those of the above equipment not covered by these National/International standards, established and proven standards of manufacturers shall also be considered. |
| 1.05.00 | In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern. |
| **2.00.00** | **CONDITIONS OF SERVICE**<br>A). Design pressure of all device, piping and auxiliary facilities for waste water treatment (evaporation process) is specified as below.<br>a) Device and tank maximum allowance : operating pressure x 1.5<br>b) Piping and auxiliary facilities : 150 lbs class flange, STD wall pipe<br>B). All equipment shall be safely accessible for monitoring, operation and maintenance from grade or platforms.<br>C). All equipment, ducts, tanks, valves and piping shall be designed and installed not to cause the vibration and hammering problems during the start-up, operation and shut-down.<br>D). Auxiliary steam if required shall be provided by owner for start-up condition only. For continuous duty, Bidder to design the various systems considering power driven equipment and the same shall be considered in power guarantee. |
| **3.00.00** | **DESIGN REQUIRMENTS** |
| **3.01.00** | **FGD Wastewater Treatment System**<br>**A. General System Description**<br>The wastewater stream will be made up of reject water from FGD, GGH washing etc. Pre-treatment shall be provided with two stage clarification i.e. primary clarifier (1x100%) & secondary lime soda softening clarifier (1x100%) to reduce the hardness and suspended solids. The Clarifier outlet will be fed to the mechanical vapor recompression (MVR), Brine Concentrator and Crystallizer system. The |

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Evaporative concentration system consisting of 1x100% or 2x50% Evaporator/Brine concentrator train(s) to be provided to accept feed from Pre-treatment. The brine concentrator blowdown shall be fed to the crystallizer(1x100%). The Crystallizer will concentrate the brine to a solid sludge suitable for solid disposal. An indicative system process flow diagram is provided in the tender.

Brine Concentrator The design of the Brine Concentrators/Crystallizers (ZLD system) will be based on the FGD blowdown design feed chemistry. To avoid scale buildup in the Brine Concentrator, calcium sulfate (seed) will be continuously circulated over the wetted surfaces in the Brine Concentrator. The wastewater enters a feed tank to deaeration and decarbonation. The wastewater is pumped through a heat exchanger that raises its temperature close to the boiling point. The vapor, created inside the tubes, passes through mist eliminators and enters the Mechanical Vapor Compressor. Compressed vapor flows to the outside of the heat transfer tubes. Wastewater passes through a deaerator counter-current to low-pressure steam, which removes non-condensable gases such as oxygen and carbon dioxide. Heat from the vapor (steam) is transferred to the cooler brine falling inside the tubes, causing some of the brine to evaporate. As the vapor (steam) gives up heat, it condenses as distillate (condensate). Hot feed combines with the concentrated brine in the sump. The concentrated brine is constantly circulated from the sump to a floodbox at the top of a bundle of heat transfer tubes. The distillate is pumped back through the heat exchanger, where it gives up heat to the incoming wastewater. Some of the brine evaporates as it flows in a falling film down the inside of the heat transfer tubes and back into the sump. A small amount of waste brine is blown down from the sump to control the brine concentration and for further treatment in the crystallizer to produce solids.

Crystallizer System

Wastewater is pumped to the crystallizer and joins the re-circulating brine. The brine slurry is pumped through a shell and tube heat exchanger (heater) to heat the brine a few degrees. Because the tubes are flooded, the brine is under pressure and will not boil. This prevents scaling in the tubes. The process vapor is directed to a knockout pot to prevent foam from being discharge to the atmosphere. The re-circulating brine enters the Crystallizer vapor body at an angle, where it swirls in a vortex. A small amount of the brine evaporates. Condensate of steam used initially shall be collected and returned for reuse. The vapor from evaporation passes

through a mist eliminator to remove entrained particles. As water is evaporated from the brine, crystals form. Most of the brine is re-circulated back to the heater. A small stream from the re-circulating loop is sent to a centrifuge or pressure filter to separate remaining water from the crystals. The solids go to disposal and the liquid is returned to the Crystallizer. A small purge may be required. Crystallizer shall be driven by the way of mechanical vapor compressor.

**B. General Design Criteria**

1) The FGD wastewater treatment system shall be designed to treat the FGD waste water of all units of Plant for 24 hours continuous operation per day and seven (7) days per week except during annual cleaning period.
2) The capacity of FGD WWT plant for ZLD for Barh-I (3x660 MW) and Nabinagar JV (4x250 MW) shall not be less than 30 $m^3$/hr and 20 $m^3$/hr respectively.
3) FGD Wastewater such as GGH washing water and filtrated water which is bled to control chloride concentration in FGD system shall be routed to Pre-clarifier(s). It shall be precipitated and overflow shall be transferred to FGD wastewater Tank.
4) FGD Wastewater tank shall be aerated by the aeration devices. The Contractor shall provide the aeration devices.
5) The FGD wastewater treatment system shall be composed of the following system to meet the specified discharge water quality as defined in the specification
    i) FGD wastewater storage system
    ii) Suspended Solid removal system
    iii) Pre-treatment system(including decalcification system)
    iv) Evaporative concentration system
    v) Chemical storage & dosing system
    vi) Sludge dewatering system
6) The FGD wastewater which is stored in wastewater tank shall be transferred to Pre-treatment by wastewater pump.
~~7)~~ To prevent scaling of the system and gypsum super saturation, the sludge recirculation shall be provided to required system. Wastewater from overflow tank shall be treated through the evaporative concentration process.
8) The removed impurities from the waste water will be bound in the form of solid cake, hence allowing the station to be complete ZLD.

9) Evaporated steam in evaporator shall be transferred to condenser and then stored in treated water tank. This stored water shall be reused for FGD make up water.
10) The Contractor shall provide wastewater treatment system to remove heavy metals such as mercury, selenium and T-N as well as sulfate, fluoride and chloride. The Contractor shall submit the technical documents with regard to treatment method for major pollutants in wastewater.
11) Flow meter with totalizer at the inlet and outlet of FGD wastewater treatment system shall be provided by the Contractor.
12) The Contractor shall design the FGD wastewater treatment system to minimize the sludge quantity. The sludge from clarifiers shall be transferred to thickeners and reuse gypsum storage tank. The overflow of thickeners shall be transferred to the FGD wastewater tank/pond, and the thickened sludge shall be transferred to the filter press for sludge dewatering and reuse.
13) The system design treatment rate shall be as specified.
14) The system shall be designed for influent water quality. Due to the fluctuating nature of the effluent wastewater chemistry, consideration must be given to ensure an operable system throughout a wide operating condition of flow and feed quality.
15) The Softening Reactor Tanks and Softening Clarifiers shall be designed for outdoor installation.
16) All Equipment shall be noted within proposal as indoor/outdoor equipment.
17) All wastewater treatment processes shall be designed to maintain treatability for design flow using only duty equipment. Operation of standby equipment shall not be acceptable for system functionality under normal working conditions.
18) Equipment shall be furnished as pre-assembled skids whenever possible.
19) Supplier must provide flow ranges and maximum design pressures at Equipment inlets and outlets.
20) The Contractor shall provide the safety shower and eye washer at the chemical feed equipment area.
21) All the design procedures, systems, and components proposed shall have already been adequately developed and have demonstrated good reliability under similar or more arduous conditions elsewhere.

**C. FGD Wastewater Storage System**

1) Wastewater from Pre-Clarifier shall be transferred to FGD wastewater tank/pond. FGD wastewater tanks(2x50%) shall designed to store FGD wastewater from all units of FGD system operated continuously for 24 hours and GGH washing water which is produced temporarily.
2) FGD waste water tank will be constructed of the concrete coated/lined with vinyl esteric resin mortar.
3) The aeration devices shall be provided and installed in FGD wastewater tank by the Contractor. The aeration devices shall be constructed of suitable corrosion resistant material. The material selection of the aeration devices shall be approved by owner.

**D. Pre-treatment System**

1) pH adjustment, reaction and coagulation tank
   a) pH adjustment, reaction and coagulation tank shall be square or rectangular type and installed on the concrete foundation. Tanks shall be equipped partition for smooth mixing of chemicals. Tanks shall be lined with min. 4.8 mm of rubber or equivalent material.
   b) The agitator for pH adjustment, reaction and coagulation tank shall be mounted on the top of those tanks and consists of shaft, propeller or paddles, lubricated bearings, constant speed and gear reducer. Inverter type of agitator shall be provided for reaction and coagulation tank in order to control rpm.
   c) The capacity of pH adjustment and reaction tank shall have a minimum 10 minute retention time in order to react with chemical. Coagulation tank shall have a minimum 20 minute retention time.
   d) All tanks and agitators shall meet the requirement as per specification.

**2) Pre-clarifier/Thickeners**

a) Clarifiers/thickeners shall be reinforced concrete coated/lined with vinyl esteric resin mortar.
b) Clarifiers and internals designed and supplied by Contractor shall include the following as a minimum:-
   i) Reaction cone.
   ii) Stilling chamber.
   iii) Launders.

iv) Tank anchor channel.

v) Drive mechanisms for sludge scraper rake and mixer.

vi) Sludge collecting arms.

vii) Access stairs.

viii) Walkway and drive platform.

ix) High/Low torque shutoff controls.

x) Overflow pipe.

c) FGD Softening Clarifier Sludge Pumps: Sludge pumps shall be located adjacent to the clarifiers, Sludge pumps shall transfer sludge from Clarifier to Sludge Storage sump/tank.

d) Interconnecting platforms, including stairs between softening reactors and softening clarifiers shall be provided.

e) The two-rake arm will move the settled solids to a central discharge point. The blade shall be bolted to the bottom chord of truss structure of rake arm. The rake and rake support parts submerged below the liquid level shall be carbon steel with rubber lining for protection against abrasion and corrosion.

f) The bleeding of clarifier sludge collector shall be consisting of manual and automatically system in accordance with time and flow rate. In addition, the facility shall be consisting of equipment for auto flushing and internal cleaning of settled sludge and sludge feed piping to prevent clogging.

g) The bottom shall have sufficient slope for solids collection. The settled sludge will form a blanket on the bottom of the clarifier/thickener and be pushed gently toward the central discharge outlet. The center scraper will clear the discharge trench and move the solid deposits toward the underflow discharge point.

h) The feed well in the clarifier/thickener center will quiet the incoming flow as it enters the sump. The feed well shall settle solids rapidly with minimum influence from turbulence.

i) The center-driving device shall have a sufficient torque to rotate the rake arm. The channel with handrail shall be installed in the top of the clarifier/thickener across the center-driving device.

j) The Contractor shall design the clarifier as followings:

- Retention time: 3 - 5 hours
- Surface loading: 15 - 20 $m^3/m^2$-day

- Efficient depth: 2 - 4 m
- Linear velocity of driver: 1 - 2 m/min

k) The Contractor shall design the thickener as followings:

- Retention time of solid: 1 - 2 days
- Surface loading: 16 - 30 $m^3$/ $m^2$-day
- Efficient depth: 3.0 - 3.7 m
- Solid content of thickened sludge: 4% or more

**E. Evaporative Concentration**

1) The Contractor shall be responsible for detailed system design, material selection, equipment fabrication and supply. Contractor is to provide a complete description of all items to be included within proposal and shall clearly identify all items required to be supplied by contractor to complete the system within their proposal. The softened wastewater shall flow to the evaporation phase of the plant. Contractor shall provide two independent trains (2x50%) to maintain for redundancy of critical operations; however both trains shall be capable of being run simultaneously.
2) Evaporative concentration shall be designed to start/stop every day.
3) Evaporative concentration, Brine concentrator consisting of **Falling film type in first** and **Crystallizer in second**, shall be designed. The compressors shall be MVR (Mechanical Vapour Re-compressor).
4) The capacity of condenser shall be 110% to process wastewater
5) Evaporator, **sludge** centrate tank, agitator, centrifuge and pumps to meet wastewater shall consist of materials for resistance corrosion.
6) Pressure vessel in evaporative concentration shall be designed as per ASME Sec.VIII or equivalent code listed above.
7) If required, the Contractor shall provide chemical storage and injection system to maintain quality of cooling water which will be used in evaporative concentration process.
8) Evaporative concentration shall be designed to reduce and avoid a scale while it is operating, and it shall be consist of accessories to wash each part. Also, brush for washing condenser shall be provided by Contractor.
9) Evaporative concentration process shall have related equipment to drain and flush the wastewater and condensate when the process is stopped or in

emergency. Also chemical storing and injection equipment are required to remove scales in evaporative concentration process equipment.

10) Drain water and washing water from Evaporative concentration shall be transferred to FGD waste water storage by sump pump.
11) Evaporative concentration washing water shall be the treated water from treated water tank of FGD WWT system.
12) All evaporative concentration pumps shall be provided with installed stand-by pump in case of 1x100% Evaporative concentration system & with a store(warehouse) spare pump in case of 2x50% Evaporative concentration system.
13) All vessel connection in evaporative concentration shall be as per the Manufacturer's proven practice.
14) Hoists shall be provided for all vessels in evaporative concentration system as per the Manufacturer's proven practice.
15) Vessel support shall be designed same as materials for vessel. Different material cannot be welded to vessel.
16) The Contractor shall provide pressure transmitter and level transmitter with root valve for each sealed vessel. Drain pipe of vessels shall be equipped with float trap, Y strainer, bypass valve & shut-off valve and connected to drainage point.
17) The hoists for O&M in the FGD wastewater treatment system shall be provided by Contractor.
18) All support platforms and access stair required for any contractor provided piping/equipment shall be provided by contractor.

**F. Centrifuge**

1) Centrifuge shall be designed to minimize the sludge moisture content, and its type shall be approved by owner.
2) Centrifuge to dehydrate solids form evaporative concentration shall be consist of Centrifuge 2x50%
3) Sludge filter press shall be manually and automatically operated.
4) All accessories of centrifuge, filter press shall be provided by the Contractor.

**G. Chemical Feed Equipment**

1) The Contractor shall provide the all required chemical feed equipment for FGD waste water treatment system. Chemical Feed Equipment shall include the

chemical storage tank, chemical dissolving tank, chemical injection tank & pumps etc. It shall be equipped with agitator, heater, fume scrubber, if required.

2) The Contractor shall design chemical tanks as followings:
   a) Chemical storage tanks : 15 days
   b) Chemical dissolving tank : 3 days
   c) Chemical dosing/injection tank : 24 hours
3) Necessary chemical shall be provided by unloading pump, depending on the water level of the chemical tank and injection tank. Also, Contractor shall provide the piping associated with Unloading pump, injection tank and connection flange to connect the chemical transport vehicles to supply the chemicals easily and quickly.
4) If chemical shall be necessary to dissolve, the chemical tanks shall be consist of dissolving and injection tank. The chemical dissolving and injection tanks shall be provided with agitator. The chemical dissolving tank will be filled with demineralized water and chemical.
5) If polymer shall be used, the Contractor shall provide the necessary tank, pumps, piping along with auto dissolving equipment.
6) Coagulant shall use the liquefied PAC.
7) All chemical tanks shall be provided with level gauge.
8) Chemical dosing/injection system equipment shall provide and maintain constant concentration, capacity and shall meet the following.
   a) The equipment and auxiliaries shall be capable on condition of constant operation and intermittent operation of WWT system.
   b) Local control panel shall be equipped with all control circuit and device to start and stop. It shall control equipment related chemical injection at local control panel. Also, operation and monitoring of FGD waste water treatment system injection equipment should be possible at main control room.
9) Chemical storage tank shall be constructed of suitable corrosion resistance material.
   a) The caustic storage tank shall be made STS304 or equivalent, and the other chemical tanks shall be made of PE/FRP or equivalent.
   b) Acid storage/injection tank shall be provided with fume scrubber. Acid storage/injection tank shall be constructed of FRP or equivalent.

10) Caustic tank shall be provided with electric heater. Caustic piping shall be provided with electric heat tracing.
11) Each tank shall be equipped with auxiliary equipment including manhole, drainage system and overflow drainage system stairs, access way, handrails and hoists etc, for operation, monitoring and maintenance.
12) Two (2x100%) chemical feed pumps per each tank shall be provided by the Contractor. The flooded suction positive displacement, diaphragm type pumps with accumulator or equivalent shall be provided for each chemical tank. The chemical feed pumps shall be made of suitable materials for feeding chemicals.
13) Chemical injection pump shall be provided as skid mounted including motor, reducer, injection rate control device, protection devices, etc on the common base plate.
14) Material of chemical unloading and injection pump shall be constructed of suitable corrosion resistance material. The material of the chemical transport and injection pump shall be approved by owner.
15) Chemical injection pump outlet shall be equipped with equipment to prevent siphon.
16) If the chemical is hazardous material, Contractor shall provide all necessary equipment and accessories.
17) Each pump shall have the following features:
    a) Pumps shall be mounted and attached to a stainless steel, coated carbon steel or fiberglass fabricated base plates with surfaces machined flat and parallel to receive feet of mounted equipment. Rolled or bent plate base plates and pump/motor support pedestals are not acceptable. Base plates shall be designed rigid and suitable for field grouting under the entire plate
    b) Pumps and entire skid shall be capable of wash-down.
    c) The design flow rate of each chemical shall be approximately 70 percent of the maximum capacity (at the maximum specified pressure) of each metering and spare pump supplied under this Purchase Order.
    d) All pumps shall be capable of fully automatic or manual control.
    e) Provide pressure gauges at the discharge of all pumps.
    f) Pumps shall have inlet and outlet isolation ball valves, suction strainers, unions, and calibration columns.

g) Provide capability to water flush the system beginning at the pump suction strainer/skid inlet manifold.

18) Diaphragm style pumps shall have the following features:

a) Controlled volume, automatic electronic variable stroke adjustment, diaphragm metering pump.

b) 2Micrometer stroke adjustment designed to permit variance from zero to full capacity during pump operation. Pumps shall be capable of manual micro meter stroke adjustment if the electronic stroke controller fails.

c) Design target flow rate must be achieved within a range of 70-90 strokes per minute.

d) Each pump shall be designed for a minimum turndown ration of 10:1.

e) For high viscosity fluids or fluids with high vapour pressures, strokes per minute shall not exceed 70.

f) Pump shall have integral suction and discharge ball check valves and oil-lubricated drive.

g) Pump relief valve shall have one of the following options: integral to pump, relief to pump suction, return to on-skid solution tank, return to bulk storage tank, return to chemical tote.

h) A pulse dampener shall be furnished on the discharge of the pumps. If pulse dampener is not required due to design of pump and allowed by Purchaser approval, Supplier shall so indicate on Bid.

i) Materials shall be suitable for the intended service and approved by Purchaser (Sulfuric acid pumps shall be Alloy 20 wetted materials with Teflon diaphragm, Antifoam and Anti-scalant shall be 316 SS wetted materials).

19) Chemical feed strainers

a) Flanged 150-lb strainers shall be furnished in each pump suction line and shall be the same size as suction piping. If strainers are Y-type, socket weld is acceptable in place of flange.

b) Sulfuric acid pumps shall have no strainers.

c) Strainers shall be of the same materials of construction as associated pump wetted materials.

d) Strainers shall be provided with blowdown valves.

20) Calibration columns

a) Furnish one transparent, plastic graduated calibration column in the suction line for each set of pumps. Columns shall be of butyrate or other chemical resistant, rigid, transparent plastic tubing rated for intended service.

b) Columns shall have threaded bottom fitting and top shall be vented back to tank or tote.

c) Each column shall be sized so that a 2 minute pump flow at the pump design flow rate shall be performed within the graduated part of the column.

d) Columns shall be provided with isolation valves.

21) Chemical feed valves

a) Materials of construction shall be the same as piping materials of construction for transfer fluid.

b) Isolation ball valves shall be provided in suction and discharge line from each pump.

c) Check valves shall be provided in each pump discharge.

d) If required, field adjustable backpressure regulating valves shall be provided on each pump discharge.

e) Relief valves shall be provided as required. The relief valve set point shall be manually adjustable.

22) Chemical feed pump suction piping, tubing and fittings

a) Materials and pressure ratings, as required.

b) Tubing shall be fully annealed and suitable for bending.

c) All connections shall terminate in a true horizontal or vertical plane.

d) Size: ½-inch OD minimum.

e) Provide ability to flush piping through the pump.

f) Each skid shall have as a minimum one quick connect suction line. Quick connect shall be same size as the suction piping. Fittings shall be of the same materials as the suction piping.

g) Unions and isolation valves shall be provided on each pump to allow easy removal of the pump.

h) Provide dual set point pressure switch (pressure switch diaphragm for sulfuric acid shall be Viton only).

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i) When specified as fed from a permanent storage tote, Supplier shall supply 6 feet of chemically compatible hose with camlock type fittings to connect tote to pump inlet manifold for each skid supplied.

H. Waste water tank

1) Unless otherwise specified, all waste water tank shall be constructed of the concrete or steel. Inner surface of the pond (side and bottom) shall be lined with vinyl esteric resin mortar minimum 6 mm thickness, tank shall be lined with minimum 4.8mm of rubber or equivalent.

2) Contractor shall install the treatment tank which can store the condensation water generated from the evaporative concentration.

3) After final treatment water condensation water of evaporative concentration shall be collected in treatment tank, to be pumped back to the FGD service storage tank.

4) Contractor shall install the access ladder and handrail for maintenance of wastewater pond/tank.

**3.02.00 Process Equipment and Accessories**

**3.02.01 Pumps and Piping**

**A. General**

1). The Contractor shall provide all necessary pumps required for the operation of the FGD system. Equipment supplied shall comply with currently approved applicable industry standards including those requirements of ANSI, ASME, ASTM, AFBMA, HI (Hydraulics Institute), and RMA (Rubber Manufacturers Association). Suction and discharge pressure instruments shall be supplied on all pumps.

2). The Contractor shall provide a complete, fully coordinated, pumping unit including pump, and as applicable, base plate, slide rails (with actuator), or other pump mounting provision, drive motor and mounting provision, gear reducers, couplings, sheaves/belts, seals and safety guards. The suction and discharge piping shall be equipped with erosion resistant piece, drain, vent, seal water, flush water and instrument connections.

3). Pumps shall be designed to receive and support all forces and moments associated with start-up, normal operation and temperature changes.

4). Unless otherwise specified, the Contractor shall provide the duplicate pumps (2x100%) or multiple standby pumps for the same service. Duplicate pumps for

the same service shall be designed to operate in parallel without undue noise and vibration or shaft breakage.

5). Contractor shall provide identical pumps for the same services preferably.

6). Impellers shall be individually statically balanced. In addition impellers shall be dynamically balanced, if the pump impeller is greater than 250 mm in diameter, or the speed is over 1800 rpm for any diameter. But, open impeller type pumps for slurry service are not dynamically balanced. If the Contractor wants to use pumps with speed greater than 1,800 rpm, then the Contractor's document must contain a detailed justification that will be subject to Owner’s approval.

7). Impellers shall not be either the maximum or minimum diameter for the pump casing size.

8). All pump casings shall be of such wall thickness as to be suitable for the maximum operating and hydro test pressures.

9). Pumps shall be provided with either packing, mechanical seals, or special arrangements designed to eliminate seal water consumption. Material selection for sealing components, sleeves and shafts shall be consistent with the corrosive and erosive nature of the service. Mechanical seal cover shall be duplex stainless steel or equivalent.

10). Bearings shall be designed to minimize deflection of the shaft and impeller. Bearings shall be provided with oil/dust tight seals.

11). Flange connections shall be dimensioned in accordance with ASME B16.5 except modifications as required for linings.

12). A method to quickly release the impeller from the shaft, without the use of come-along, shall be incorporated into the design.

13). The axial thrust of the pumps shall be so compensated that there will be no axial movement or float of the shaft at any flow from minimum capacity to maximum capacity under the specified conditions of operation.

14). Pumps with special construction features which facilitate service and maintenance will be given special consideration.

15). The final performance curve for all pumps shall rise steadily from the design point to pump shutoff.

16). The Contractor shall indicate the minimum flow at which each pump can operate continuously without suffering damage. The Contractor shall also indicate the continuous maximum allowable run out flow for each pump.

17). Wetted pump components such as casing internals, impeller and shaft sleeve shall be suitable for the fluid pumped, including its erosive and corrosive characteristics. The material chosen for pump shall be proven type in similar application. Reference list of previous installation for similar application shall also be furnished to the employer.

18). The large horizontal pumps with vertically split casings shall be designed to permit removal of the impellers, shafts, bearings, etc, without disassembling the suction or discharge piping other than for pump maintenance spool pieces.

19). The coupling and mechanical seal or stuffing box for packing shall be arranged so it is not necessary to remove the motor to service these items.

20). Couplings shall be spacer-type (stainless steel flexible double disk type or flexible gear type), where required, to allow dismantling of the pumps without disturbing the motors or the pump pedestals. Metal coupling guards shall be provided to cover couplings and exposed key ways.

21). The total number of different sized pumps and pump manufacturers shall be minimized.

22). When pumps of same capacities and same services are furnished, all components including spares and spare assemblies shall be completely interchangeable.

23). All Piping shall be suitable for the fluid therein, including its erosive and corrosive characteristics. The material chosen for piping shall be proven type in similar application. Reference list of previous installation for similar application shall also be furnished to the employer.

**B. Wastewater Pumps**

1) All components of the FGD wastewater pumps which come into contact with the wastewater shall be made of corrosive and abrasive resistant material with excellent durability for the intended service.

2) Parts subject to wear or requiring adjustment and inspection shall be accessible and capable of reasonably convenient removal.

3) The material of centrifugal pump included in Evaporative concentration system shall be complied with below requirement.

- Casing: ASTM A890 Gr. 5A or better
- Impeller: ASTM A890 Gr. 5A or better
- Shaft: SM45C or better (STS 316L and STS 304 will not be acceptable.)

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**C. Chemical Feed/injection Pumps**

1) Chemical injection pumps shall be the metering, positive displacement diaphragm type and shall be furnished complete with drive motors, gear reducers, stroke control devices, and guards, all mounted on a common base plate.
2) The pumps for acid shall be constructed of PE/PP/FRP or equal and the pumps for caustic shall be constructed of 316 stainless steel wetted parts or equal. The other pumps shall be made of suitable materials for handling chemicals.
3) All Chemical feed rates shall be automatically controlled based on process variables and/or other appropriate measurements in the ZLD controls system.
4) For each chemical feed system identified above, the Equipment shall include, but not be limited to, the following:
   a) Metering pumps, valves, calibration columns and suction strainers.
   b) Low level shutoff controls for each tote or storage tank and associated pumps.
   c) Associated instrumentation and controls specified below and required for a complete operational system.

**3.02.02 Agitators**

1) Agitators shall be provided for all sumps and tanks where slurry collects and for chemical tanks, or where mixing is required by the FGD system process. A sufficient number of agitators shall be deployed at each location.
2) Design of agitators shall be proven type.
3) Agitators shall ensure that all the suspended solid particles in the slurry shall be adequately dispersed throughout the tank. Each agitator shall be complete including, but not be limited to, shaft, shaft seals, impellers, mounting provision, speed reducer and motor.
4) Materials of construction of the agitator components shall withstand normal operating and upset conditions including slurry concentration, volume and pH variation. Shaft shall be of solid construction.
5) Agitator shaft bearings shall be designed and spaced properly for minimum deflection of the shaft.
6) The operating speed shall not be within 20 percent of any of the agitator's critical speeds.
7) Agitators shall be shipped either fully assembled or in the largest shippable subassemblies. The Contractor shall design and furnish hoisting provision at

each tank for replacing completely assembled agitator and/or its largest subassembly. Agitators shall be designed to enable servicing and replacement of packing without draining the tank contents.

8) Agitators shall be oil-lubricated with provision for filling and draining.

9) Side entering agitator gearing shall be of helical bevel type design. Worm gearing shall not be used. Agitator speed shall be adjustable by means of changing gears. Changing gears shall be accomplished without disassembling the agitator.

10) Agitators may be either constructed of the appropriate metallurgy or rubber lined for the service chemistry.

11) Side entering agitators shall come complete with support legs by the steel structure on foundation.

12) Also, the strength by the agitating motion and weight shall not have effect on the absorber shell.

13) Side entering agitators shall be of the non-leakage type. Seal water, if required, shall be fed continuously, whenever the tank is in service. Hoist and monorail shall be provided for maintenance.

14) All agitators shall be driven by electric motors. Belt drive shall not be employed for speed reduction.

15) The number of different agitators shall be minimized in order to minimize spare parts requirements.

16) The degree of agitation achieved shall be that required by the process. Agitators shall be sized that, in the event of agitator failure, upon restoration of the agitator. All material which has settled as a result of the agitator failure shall be completely resuspended within 8 hrs after the agitators were inoperable for up to 24 hrs.

17) Flow patterns from the impeller shall be capable of maintaining solids in suspension with and without recirculating flow from the tank. The flow pattern shall also be capable of resuspension solids within two hours after a short (two hours) shutdown, such as a power failure.

18) The impeller and shaft shall be easily removable from inside the tanks without disturbing the speed reducers or the motor.

19) lmpellers shall not be integrally welded to the shaft.

20) The agitators shall be designed and installed to minimize the vibration.

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**3.02.03** **Tanks**

1) The Contractor shall design and install the tanks complete with all the necessary connections and appurtenance, including manholes, hand holes and roof drain, as required for the tank service.
2) Tanks shall be provided with drain connections and associated valves to allow the tank to be easily drained to sump. Slurry tank bases shall be designed to minimize accumulation of solids and for ease of cleaning. All slurry tanks including filtrate tanks shall have agitators to provide adequate agitation of the slurry. Slurry tanks shall be provided with screen at the inlet nozzles.
3) Connections for lined pipe and plastic pipe shall be flanged.
4) Tanks in contact with slurry or reacted slurry shall be used appropriate corrosion resistant metal or linings such as flake glass or rubber, as specified herein. Mill slurry tanks must be constructed of rubber lined carbon steel. Each lining/coating procedures shall be submitted and subject to owner' approval.
5) All tank storage capacities except emergency storage tank shall be based on the minimum available storage capacity. The minimum available storage capacity is defined as volume from low level to high level (minimum 150 mm below the tank overflow level). When low level, the pump operation and/or solid suspension shall be good condition.
6) The Contractor shall furnish all necessary tanks, which shall have storage and surge capacity required for operation of the FGD system throughout the entire load range and present this information.
7) All tanks shall be designed to withstand the loads imposed by filling with the liquid to the maximum extent possible as well as the forces caused by wind and seismic loads.
8) Tanks and access hatches shall be designed in accordance with API Code 650. Remote level indicators or alarm shall be provided for all tanks. Tanks shall be provided with all necessary walkways and stairs with handrail required to provide access to areas requiring periodic maintenance or inspections. The Contractor shall provide rail guards at the periphery of the tank roof, and the spiral stair with handrail for the tank height of 3 m or more.
9) The Contractor shall ensure that the agitator support structure is arranged to enable agitator removal without destruction (field cutting or touching) of any support steel.

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10) For pressure vessels, the Contractor shall provide material specification, design parameters (ASME Section Vlll), manufacturing drawings and inspection reports.

11) Tanks shall have at least one, side hinged, bolted, circular shell manhole.

12) The drain size of slurry tanks shall be minimum 200 mm.

**3.02.04 Lifting Devices**

1) The Contractor shall furnish hoists with trolleys and other lifting appliances with associated support, crane rails, runways and lifting eyes required for the adequate maintenance of the equipment to be removed for routine maintenance and weighing in excess of 50 kg for Tanks,Equipment at FGD wastewater treatment system.

2) Trolley-hoists shall be electric type and shall be manufacturers' standard design in so far as practicable in meeting the requirements of this specification. The Contractor shall supply monorail beams as required to provide access to all equipment to be served by the hoists.

3) The trolley-hoists in their entirety shall comply with all current applicable local and government statutes, regulations, and safety codes relative to the design, construction, and operation of hoists in the locality where the hoists will be installed.

4) As a minimum two (2) trolley-hoists of each size shall be furnished for installation and use.

(Example: Seven(7) hoists are to be furnished. The sizing criteria call for six(6) 100 kg hoists and one(1) 150 kg hoist. To meet the above requirement, the Contractor will supply five(5) 100 kg hoists and two(2) 150 kg hoists. That is to say, one(1) hoist will be oversized to meet the requirement).

5) Monorails shall be arranged to permit movement of lifted equipment from the installation area directly to a truck, without transfer of hoists or re-rigging.

6) Trolley-hoist shall be floor controlled from a pushbutton station, suspended from a fixed point on the trolley. One button shall be provided for each direction of motion of the hoist-trolley, plus stop and start buttons. Where necessary, the Contractor shall provide a torque reel for vertical movement of the pushbutton station. Trolley-hoists shall receive a finish coat of epoxy yellow paint applied in accordance with the manufacturer's instructions. A capacity plate showing

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rated capacity of the hoist shall be placed on hoists in such a manner as to be easily legible. Pushbuttons shall be protected with neoprene hoods.

7) Control panel enclosures and pushbutton station shall be suitable for operation in a corrosive environment, preferably NEW 4X or high impact fiberglass construction.

8) The Contractor may find that the layout and size of equipment lends itself to the use of a bridge crane in lieu of trolley-hoists. If bridge cranes are furnished they shall meet the requirements of this Paragraph. The Contractor shall provide detailed information in the proposal on any bridge cranes for owner's acceptance.

9) A hoist shall be provided at the mist eliminator level to assist in removal and replacement of mist eliminators. The hoist shall be positioned to minimize the distance the mist eliminators will have to be hand carried.

**3.02.05** **Falling film evaporator(FEE) and accessory equipment design:**

1. FFE trains shall include following as a minimum:
   a) Feed pump
   b) Feed tank
   c) Feed heat exchanger
   d) Deaerator
   e) Falling film evaporator
   f) Vapour compressor
   g) Evaporator recirculation pump
   h) Hydro cyclone and associated pump
   i) Hot distillate tank
   j) Distillate pump
2. Seeding system
3. All valves and instrumentation.

**A). Falling film evaporator(FEE)**

1. One (1) per evaporator train.
2. The FFE shall be constructed of:
   i). Brine wetted parts, material with a PREN of greater than 40.
   ii). Tubes, Titanium Gr. 2.
   iii). Upper tube sheet, Titanium Gr. 1 clad on 316 SST.
   iv). Shell, duplex SST.

v). The plate thickness shall be a minimum of 6.35 mm (0.25 in). Tube wall thickness shall be a minimum of 22 BWG (0.028 in).

3. The FFE shall be designed for outdoor service with the accessory equipment located indoors. All outdoor equipment including piping shall be supported on foundations.
4. All wetted materials of construction shall be selected for severe corrosion service and are to be as specified. Any changes in proposed equipment, materials selection or manufacturer/Contractor during design shall be approved by Purchaser prior to incorporation into the design.
5. The design of equipment, arrangement of components, and routing of piping shall consider operational and maintenance accessibility of components. Equipment, piping, valves, and instruments shall be arranged so that when installed, components requiring manipulation, observation, or maintenance will be readily accessible and safe to operating and maintenance personnel.
6. Contractor shall include provisions for automatic flushing of piping upon shutdown and as operationally required.
7. Chemical feeds shall be injected tangentially into tanks or using retractable injection quills into piping.
8. Contractor shall include provisions for automatic washing of mist eliminators and Vapour Compressor blades. Wash water shall be hot distillate.
9. Any vents from the evaporator shall be supplied with bird screens.
10. The FFE shall contain a vertical shell-and-tube heat exchanger (condenser) with brine cascading into an internal reservoir or sump. The Bidder's proposal shall fully describe the evaporator design features including the following components:
    a) Description of tube attachment to the tube sheet (both upper and lower tube sheet) and evaporator volume and design.
    b) Manways shall be located above tubesheet and at sump level. Minimum manway diameter is 30". Access via stairs shall be supplied to the evaporator sump manways. Access via ladder shall be supplied to the tubesheet manways.
    c) Mist eliminators may either be integral to the evaporator or located in ductwork adjacent to the evaporator. Mist eliminator design and material

including online provisions for cleaning and method of control. Access to mist eliminators shall be via stairs.

d) Location of all site ports.

**B). Evaporator Feed Tank**

1) The Evaporator Feed Tank volume shall residence time, at 100% level, of no less than 30 minutes.
2) Feed tank shall be constructed of fiberglass material (FRP) fabricated per the requirements of ASTM D3299 and D4097. Tank design shall incorporate a double surface veil comprised of 10 mil of nexus and 20 mil of c-glass.
3) Tank mixers shall be furnished to provide continuous agitation.
4) Support for the agitator shall be integral to the tank structure. All wetted materials for the mixer shall be suitable for the service. Access to the agitator shall be provided with platforms at top of tank. Minimum access of 3'6" shall be provided on 2 of 4 sides around the agitator for maintenance personnel.
5) All chemicals injected into the system shall be provided with retractable injection quills of suitable materials and injected into the tank below all ranges of operating liquid level.

**C). Evaporator Feed Pumps**

1) Contractor shall provide Evaporator Feed Pumps for FFE. Two (2) x 100% Evaporator Feed Pump shall be installed; one operating and one spare in case of 1x100% Evaporative concentration system. One (1) x 100% Evaporator Feed Pump shall be installed per FFE train with a store stand-by Evaporator Feed Pump in case of 2x50% Evaporative concentration system.
2) Feed Pump materials shall be ASTM A890 Gr. 5A or better impeller and casing.
3) Pump shall use a double mechanical seal.

**D). Feed/Distillate Heat Exchangers:**

1) One (1) per evaporator train.
2) The heat exchanger's purpose is to recover sensible heat from the distillate to preheat the feed water. Heat exchanger shall be plate-and-frame type sized to include 20 percent additional plates with no modifications. Gaskets shall be clip-in type.
3) Heat exchanger shall be constructed of Titanium Gr. 1 plates with Carbon Steel end plates and support bars.

4) Contractor shall furnish the following instrumentation:

   a. Differential pressure across the cold (feed) side of each heat exchanger.

   b. RTD's with thermowells on each stream in and out of the heat exchanger

5) The heat exchanger shall be provided with a permanently installed local cleaning system with quick connect hoses for periodic cleaning of the heat exchangers. Cleaning system shall, at a minimum, include an on-skid pump, heater, 500 lt. tank and agitator.

6) The heat exchanger shall be provided with suitable high point vents and low point drains.

**E). Deaerator:**

1) One (1) per evaporator.

2) The deaerator shall be constructed of 2507 duplex SST material with glass reinforced polyethylene random packing.

3) The deaerator shall be provided to remove non-condensable gasses from the heated feed water. Stripping steam from the distillate tank shall be used as the carrier for removal of non-condensable gasses.

4) The deaerator shall use a disc and donut configuration and shall be provided with an inlet nozzle designed to evenly distribute feed water over the packing. The deaerator vent or vent piping shall be supplied with bird screens.

5) A pressure transmitter shall be installed above the packing for vapour pressure monitoring and feed rate control of stripping steam from the distillate tank to the deaerator.

**F). Vapour Compressor:**

1) One (1) per evaporator.

2) The compressor casing shall be 316 SST and the impeller duplex SST.

3) Compressor, sealing methods, lubrication, and instrumentation shall be designed to be suitable for steam applications. The compressor bearing lubrication system shall be designed to provide continuous bearing lubrication during all modes of operation. Compressor shall be air cooled. If water cooled, the system shall be designed for a closed loop system with integral cooling.

4) The compressor and ancillary system shall be provided preferably on a common baseplate to facilitate installation and alignment. Vibration transmitters and monitoring equipment are required. To the maximum extent practical the vibration monitoring equipment and lubrication systems shall be mounted on the common baseplate. Motor shall be shipped loose for site assembly.
5) A compressor enclosure shall be supplied to meet contract noise limits.
6) Additional required equipment
   i). Shaft driven lube oil pump
   ii). Electrically driven Lube oil pump.
   iii). Lube Oil cooler
   iv). Electric Lube Oil heater
7) After the manufacture, following tests for Vapour Compressors shall be demonstrated at membrane manufacturer's works in the presence of Employer's representative and contractor:
   i) Performance Test with job motor
   ii) For detailed Quality Assurance tests, QA chapter shall be referred to.
   iii) One Compressor shall be tested at shop with job motor and guaranteed power consumption shall be determined based on shop test results of tested compressor multiplied by number of working compressors.
   iv) The responsibility for conducting the test will be with the Contractor and Contractor shall make all the arrangements for carrying out tests at compressor manufacturer's works. In case such test facilities are not available at manufacturer's works, the test may be carried out at any other test facility with the approval of Employer. All cost associated with testing at contractor's works or at any other test facility shall be borne by the contractor & shall be included in the contract price. Bidder shall submit the test procedure for Employer's approval.

**G). Evaporator Recirculation Pumps:**

1) Evaporator recirculation pump shall be furnished for evaporator train and designed for continuous service with minimal maintenance requirements. Two (2)x100% Evaporator recirculation Pump shall be installed; one operating and one spare in case of 1x100% Evaporative concentration

system. One (1) x 100% Evaporator recirculation Pump shall be installed per FFE train with a store stand-by Evaporator recirculation Pump in case of 2x50% Evaporative concentration system.

2) The pump casing and impeller shall be ASTM 890 Gr. 5A.
3) Recirculation pump mechanical seal shall be continuously purged to cool the seal and to minimize the amount of solids at the seal faces. Seal water shall be of service quality.

**H). Distillate Tank:**

One (1) distillate tank which shall be provided per evaporator train sized to provide not less than 10 minutes retention at the maximum treatment rate. Any vents from the distillate tank shall be supplied with bird screens.

The tank shall be fabricated from 316L SST.

**I). Distillate Pumps:**

1) Two (2) x 100% Distillate Pump shall be installed; one operating and one spare in case of 1x100% Evaporative concentration system. One (1) x 100% Distillate Pump shall be installed per FFE train with a store stand-by Distillate Pump in case of 2x50% Evaporative concentration system..
2) The distillate pump casing and impeller shall be 316L SST
3) One (1) x 100% centrifugal distillate pump.
4) Distillate pump shall transfer distillate from the distillate tank to the heat exchanger for sensible heat recovery.

**J). Seeding System:**

1) One (1) seeding system.
2) The seeding system shall be of proven type and the contractor shall submit the detail scheme for employer's approval. Reference list of previous installations for similar application shall also be furnished to the employer.
3) Seed tank (which is also the evaporator blowdown tank) and pump shall be supplied to provide calcium sulfate feed slurry to the evaporator recirculation pump suctions of the FFE.
4) Tank shall be of 316L SST construction.
5) Tank shall be furnished with an agitator to blend dry calcium sulphate with feed water at time of seeding.
   i) Agitator shall be propeller type.

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ii) Materials of construction shall be suitable for intended purpose, identified by Contractor within the Proposal and approved by Purchaser.

6) Tank volume shall be at 10m3 minimum.

7) Access via stairs shall be provided to the top of the seed tank to facilitate maintenance of tank agitator and filling of tank with dry calcium sulfate.

**K). Evaporator Blowdown Pump:**

1) Two (2)x100% Evaporator Blowdown Pump shall be installed; one operating and one spare in case of 1x100% Evaporative concentration system. One (1) x 100% Evaporator Blowdown Pump shall be installed per FFE train with a store stand-by Evaporator Blowdown Pump in case of 2x50% Evaporative concentration system. Blowdown pump shall be provided to transfer brine blowdown

2) Casing and impeller shall be fabricated of A890 Gr 5A

**L). Hydrocyclone Pump:**

1) One (1) per evaporator train.

2) The pump casing and impeller shall be ASTM A890 Gr. 5A or equal.

3) Evaporator train shall have a centrifugal hydrocyclone feed pump.

**M). Hydrocyclone:**

1) One (1) per evaporator train.

2) Materials shall be 6% Mo SST/Ceramic/Equivalent.

3) Evaporator shall have a hydrocyclone for automatic control of dissolved and suspended solids in the evaporator sump.

**3.02.06** Crystallizer, Crystallizer Feed Tank, Crystallizer Brine Tank & Crystallizer heat exchanger equipment:

1) Crystallizer Feed Tank and Pump-

One (1) Crystallizer Feed Tank, shall be provided for storage of evaporator effluent brine. The tank will be utilized for interim storage of brine both during normal operation and for short periods when maintenance is being performed on the crystallizer/centrifuge system. Materials of construction shall be Super Duplex 2507. The tank shall be furnished complete with Alloy C-276 agitator, level and temperature controls, and other required accessories. Feed pump shall be ASTM A 890 Gr. 5A.

2) Crystallizer Heater

One (1) forced circulation (1x120%), horizontally mounted, TEMA "C" design heat exchanger shall be furnished. Tubes to be made of Ti Gr 16, Tube sheets: Ti Gr 16, cladding on 316 SS, Shell to be made of 2205 Or 316 LSS. Head to be made of C 276.

3) Crystallizer Vapor Body

One (1) body of Alloy C 276 construction or higher grade, including de-entraining device. A cone bottom to be included. All other necessary accessories, controls, etc. shall be included. Crystallizer main circulating piping Inconel 625 or better.

4) Crystallizer Recirculation Pump

One (1), 100% duty pump constructed of ASTM A890 Gr. 5A or better shall be furnished for circulating slurry through the process. Pump type may be centrifugal or axial flow. Pump shall be furnished complete with double mechanical seals and a discharge pressure gauge.

5) Surface Condenser

One (1) surface condenser to condense crystallizer distillate shall be provided. Material of construction shall be 316L SS.

6) Anti-Foam Feed Tank and Pump

Complete feed system for injection of anti-foam to appropriate points in the process shall be included. The feed system shall include feed tank, agitator, and positive displacement metering pumps. Tank shall include a low-level alarm.

7) Caustic Feed Tank and Pump

Complete feed system for injection of caustic to appropriate points in the process shall be included. The feed system shall include feed tank, agitator, and two positive displacement metering pumps. Tank shall include low level alarm.

8) Crystallizer Distillate Tank

One (1) distillate tank shall be included, to provide positive suction head to the distillate pump. The tank shall collect both crystallizer distillate and return condensate from the crystallizer heater. Tank shall be of 316L stainless steel construction or other compatible material.

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9) Crystallizer Distillate Pump

One (1) 100% duty, centrifugal pumps shall be furnished to transfer distillate from the distillate tank to be combined with the Evaporator distillate. Should the crystallizer distillate be contaminated, it shall be discharged back to the Wastewater Storage Tank. The distillate pump casing and impeller shall be 316L SST or better.

10) Recirculation piping and Vapor duct

Recirculation Piping shall be provided in C 276 material, Vapor duct to be made of 2205.

11) Mechanical Vapour Compressor

One (1), 100% duty, centrifugal compressor shall be provided. Compressor shall have 2507 casing, 2507 impeller . Inlet guide vanes or an outlet damper valve shall be provided for flow control. Oil cooler, filter and vibration monitoring shall be included as required.

12) Dewatring System: Solids generated in the crystallizer process are dewatered in the dewatering system. Centrifuge or Belt Filter Press can be offered for dewatering salts. Material of construction for wetted part should be Hastelloy C or equal. Filter cloth can be vendor's standard material based on application.

13) Centrate Tank and Centrate Pump

Centrate generated from dewatering system is collected in the Centrate tank. Brine is recycled back to crystallizer process. A small amount of purge can be separated from centrate pump discharge of necessary. Material of constriction for brine wetted material shall be Hastelloy C or equal.

**3.02.07 General**

a) All equipment and material furnished by the contractor shall have an acceptable history of satisfactory reliable operation and the Contractor shall offer only proven design in successful operation in similar application at previous installations.

b) Type of equipment and material of construction for various applications in the plant shall be selected by the Contractor as per its proven practice unless specified elsewhere.

c) Contractor shall take full responsibility that all materials and components of valves, pumps, piping and other equipment and appurtenances shall be compatible with the respective fluids herein.

d) All fasteners such as nuts, bolts etc. shall be of stainless steel.

e) Equipment shall be fabricated, assembled, installed and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer as approved by the Employer.

f) All pressure vessels shall be tested and code-stamped conforming to ASME Section VIII, Boiler and Pressure Vessel Code. ASME Section IX certified welders shall perform welding of fabricated equipment per ASME procedures.

g) The design of equipment, arrangement of components, and routing of piping shall consider operational and maintenance accessibility of components. Equipment, piping, valves, and instruments shall be arranged so that when installed, components requiring manipulation, observation, or maintenance will be readily accessible and safe to operating and maintenance personnel.

h) The owner shall:

   i). Have full access to the equipment during manufacturing.

   ii). Be notified when manufacturing schedule is arranged, and be kept informed during manufacture of any major problems or rework that may affect delivery of the equipment as scheduled.

   iii). Be notified, should any work, fabrication, or material be supplied by a subcontractor or outside bidder, prior to release to the bidder. Engineer reserves the right of approval of any subcontractor and also the right to inspect work, fabrication or material being subcontracted at the subcontractor's location.

   iv). Each Bidder furnished equipment skid shall be assembled and shop tested as completely as possible (both mechanically and electrically) including stroking of valves. All rotating parts and shaft couplings shall be statically and dynamically balanced in the shop.

   v). Each pressure vessel shall be subjected to testing specified within ASME. Skid piping and other piping assemblies shall also be hydrostatically shop tested per ASME B31.1.

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vi). The Bidder shall notify the owner fifteen (15) working days prior to performing the following for potential owner witness or inspection:

a) Hydrostatic testing.

b) Functional testing.

vii). Coatings & Galvanizing:

a) Unless otherwise required, the Bidder's standard finish coating systems shall be applied in the shop to ferrous metal surfaces of equipment and materials. The coating system shall provide resistance to corrosion caused by weather and industrial environments. Surfaces to be primed only shall use a zinc rich primer. Surfaces shall be cleaned, prepared and coated in accordance with the coating manufacturer's instructions. Each shop fabricated vessel and tank shall be complete.

b) Stainless steel and FRP surfaces shall not be painted.

c) All exterior coating shall be epoxy black powder, no galvanized outdoors.

d) Bidder shall fully describe the proposed coating system for all Bidder supplied equipment. Equivalent coating systems by other manufacturers must be submitted for approval to the Engineer/Owner prior to fabrication of the equipment.

# SUB-SECTION-I-M8

# PIPING

## LOW PRESSURE PIPING

1.00.00 **EQUIPMENT SIZING CRITERIA**

1.01.00 All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

1.02.00 For all Low Pressure piping systems covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.

1.03.00 Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:

a) **Water Application**

| | Pipe Size | Water Velocity in m/sec<br>Below 50 mm | 50-150 mm | 200 mm & above |
|---|---|---|---|---|
| (a) | Pump suction | ------ | 1.2-1.5 | 1.2-1.8 |
| (b) | Pump discharge and recirculation | 1.2-1.8 | 1.8-2.4 | 2.1-2.5 |
| (c) | Header | ------ | 1.5-2.4 | 2.1-2.4 |

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:

| | | |
|---|---|---|
| (i) | Carbon steel pipe | 100 |
| (ii) | Ductile Iron. | 140 |
| (iii) | Rubber lined steel pipe | 120 |
| (iv) | Stainless steel pipe | 100 |

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.

(b) **Compressed Air Application**

Compressed air 15.0 m/sec.(under Average Pressure & Temp. conditions)

1.04.00 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.

1.05.00 Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.

1.06.00 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered (except stainless steel piping).

1.07.00 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.

1.08.00 High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.

1.09.00 Material of construction for pipes carrying various fluids shall be as specified elsewhere.

1.10.00 Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.

1.11.00 Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.

1.12.00 Threaded joints shall be provided with Teflon sealant tapes.

1.13.00 Following types of valves shall be used for the system/service indicated.

| **SYSTEM** | **TYPES OF VALVES** | | | | | |
|---|---|---|---|---|---|---|
| | Butterfly | Gate | Globe | Check | Ball | Plug |
| Water | x | x | x | x | x | |
| Air | | x | x | x | x | |
| Drains & vents | | x | x | x | | |

1.14.0 Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.

| | |
|---|---|
| 2.00.00 | **TECHNICAL SPECIFICATION** |
| 2.01.00 | **GENERAL** |
| | Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc. |
| 2.02.00 | **Pipes and fittings** |
| 2.02.01 | All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification. |
| 2.02.02 | Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum. |
| 2.02.03 | Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses. |
| 2.02.04 | Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M). |
| 2.02.05 | Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer. |
| 2.02.06 | The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout. |
| 2.02.07 | Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects. |
| 2.02.08 | For rubber lined ERW pipes, beads shall be removed. |
| 2.02.09 | Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes. |

2.02.10 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.

2.02.11 For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.

Transient analysis /surge analysis where ever specified and required shall be conducted in order to determine the location , number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.

2.03.00 **Material**

2.03.01 Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified, The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.

2.03.02 No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.

2.03.03 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.

2.03.04 All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.

2.03.05 Material of construction for pipes carrying various fluids shall be as follows:

| Sl No | Type of Fluid | Material |
|---|---|---|
| 1. | i) Ordinary Water (Raw Water, Clarified Water, etc.)<br>ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH-corrected & ACW drain water) | IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E'Gr.B/IS-3589 Gr. 410 /IS-1239 Heavy. |
| 2. | i) Demineralised water,<br>ii)Alkaline solution (ECW system chemical dosing) | Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above.<br>Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below |
| 3. | i) Drinking (potable) water<br>ii)Compressed air (Instrument & service air) | ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent. |

2.03.06 In water lines, pipes upto 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr.B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.

| | |
|---|---|
| 2.03.07 | Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr.E-250B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr.E-250B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be). |
| 2.03.08 | In demineralised water service, the pipes upto 50 Nb shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.<br><br>Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification. |
| 2.03.09 | Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized). |
| 2.03.10 | Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses. |
| 2.03.11 | Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained. |
| 2.03.12 | If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code. |
| 2.04.00 | **Field routed pipes:** |
| 2.04.01 | Pipe lines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipes and submit to Employer for approval. |
| 2.05.00 | **Slope/Drains and Vents** |
| 2.05.01 | Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes. |

2.05.02 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

2.06.00 **Pipe Joints**

In general all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.

2.06.01 **Screwed Joints**

(a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS: 554 unless specified otherwise.

(b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be field joined by welding for protection of Galvanising Zinc layer. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.

(c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.

(d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing.

(e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.

2.06.02 **Welded Joints**

(a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.

2.06.03 **Flanged Joints**

(a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.

(b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.

(c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

2.07.00 **Bends/elbows/mitre bends/ Tees/ Reducers & other fittings**

2.07.01 For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11.Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1).

However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.

2.07.02 For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.

2.07.03 For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.

2.07.04 Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes upto and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.

2.07.07 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

2.08.00 **Flanges**

2.08.01 Flanges shall be slip on type. Welding of flanges in tension is not permitted.,

2.08.02 All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. E-250B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 or equivalent.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

2.09.00 **Specific technical requirement of laying buried pipe with anti corrosive treatment**

The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.

2.09.01 **Trenching**

(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.

2.09.02 **Preparation and cleaning of piping**

(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand or grit blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.

(b) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.

2.09.03 **Coating and wrapping/ Anti corrosive Protection Coal tar tape**

a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:

(1) Coating primer (coal tar primer)

(2) Coating enamel (coal tar enamel)

(3) Wrapping materials.

All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.

Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat.
Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of. Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.

Total thickness of completed coating and wrapping shall not be less than 4.0 mm.

b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar primer in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total nominal thickness of the finished protective coating shall be 4.0 mm.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 2.09.04 | **Trench bed preparation and back filling**<br><br>Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822. |
| 2.09.05 | **laying of galvanized steel (GI) pipes**<br><br>All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste.<br><br>All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and " anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also. |
| 2.10.00 | **Cleaning and flushing** |
| 2.10.01 | All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag. |
| 2.10.02 | Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing . However for pipe sizes below 100nb the pipes may be cleaned internally by compressed air blowing as an alternative to internal blast cleaning. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done by air blowing only. |
| 2.10.03 | After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines. |
| 2.10.04 | All compressed air pipe work shall be cleaned by blowing compressed air. |
| 2.11.00 | **Specification for hangers and supports** |
| 2.11.01 | All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent. |
| 2.11.02 | The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1. |
| 2.11.03 | At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction. |
| 2.12.00 | **Design/Construction/Material Particulars of Gate/ Globe /Check /Butterfly / Ball / Air release /Float valves / Moisture Traps.** |
| 2.12.01 | **GENERAL**<br><br>(a) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.<br><br>(b) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. |

(c) The valves coming in vacuum lines shall be of extended gland type and/or water sealed.

(d) The actuator-operated valves shall be designed on the basis of the following:

(1) The internal parts shall be suitable to support the pressure caused by the actuators;

(2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.

(3) All actuator-operated valves shall be provided with hand operated gearing mechanism also.

(4) All actuators operated valves shall open/ close fully within time required by the process.

(e) Valves coming under the purview of IBR shall meet IBR requirements.

(f) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.

(g) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer

2.12.02 **VALVE BODY MATERIAL**

Valve body material for various services shall be as follows:

Valve body material for water application like Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) , drinking water etc. shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below.

For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water: SS body and disc along with SS internals. However for butterfly valves, Cast Iron /Ductile Iron/SG iron/carbon steel body and disc with elastomer lining are also acceptable.

Condensate: Cast Carbon Steel / Forged Carbon Steel.

2.12.03 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

**Standards and Codes**

AWWA-C-504 Rubber seated butterfly valves.

| | | |
|---|---|---|
| | BS-5155/EN-593 | Cast iron and steel body butterfly valves for general purpose. |
| | IS-778 | Gun-metal gate, globe and check valves for general purpose. |
| | BS-5154 | Copper alloy globe/globe stop and check and gate valves for general purpose. |
| | IS-780 | Sluice valves for water works purpose (50-300 mm size) |
| | IS-2906 | Sluice valves for water works purpose (350-1200 mm size) |
| | IS-5150 | Cast iron wedge and double disc gate for general purpose. |
| | BS-5152 | Specification for cast iron globe valves. |
| | BS-5153 | Cast iron check valves for general purpose. |
| | IS-5312 | Swing check type reflux (non-return) valves. |
| | ANSI B 16.34 | Standard for valves. |
| | API-594 | Standard for Dual-check valves. |
| | API-600 | Steel gate valves. |
| | ANSI-B-16.10 | Valves face to face and other relevant dimension. |
| | API-598 | Valves inspection test. |

2.12.04 **End Connections**

The end connections, shall comply with the following:

Socket welding (SW) - ANSI B 16.11

Butt Welding (BW) - ANSI B 16.25.

Threaded (SC) - ANSI B 2.1

Flanged (FL) - ANSI B 16.5& AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges).

2.13.00 **Gate/Globe/Check Valves**

(a) All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).

(b) All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.

(c) All gun metal body valves shall have screwed ends.

(d) All flanged end valves/specialties. shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints.

(e) Gate/sluice valves shall be used for isolation of flow. All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc. Gate valves shall be provided with the following accessories in addition to other standard items:

(1) Hand wheel

(2) Position indicator (for above 50 mm NB valve size)

(3) Draining arrangement wherever required.

(f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction. Preferably, the valves shall be of the vertical stem type. Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.

The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.

(g) Check valves shall be used for non-return service. They shall be swing. check type or double door (Dual plate)check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB.

(h) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);

(i) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.

(j) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing. The valves shall be preferably outside screw & yoke type.

(k) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.

(l) All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.

(m) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

2.13.01 **MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)**

(a) The materials shall generally comply with the following:

(1) **Cast Steel Valves**

| | |
|---|---|
| Body & bonnet | ASTM A 216 Gr. WCB/ ASTM A 105 |
| Disc for non-return Valves | ASTM A 216 Gr. WCB/ ASTM A 105 |
| Trim. | ASTM A 182 Gr. F6 or Equivalent |

(2) **Stainless steel valves**

| | |
|---|---|
| Body & Bonnet | SS 304 |
| Disc | -do- |
| Trim. | SS 316 |

(3) **Cast iron valves**

| | |
|---|---|
| Body & bonnet | BS 1452 Gr. 14/ IS-210 Gr. FG 260 |
| Seating surfaces and rings | 13% chromium steel/ 13% Chrome overlay |
| Disc for non-return valves | BS 1452 Gr. 14/IS-210 Gr FG 260 |
| Hinge pin for non-return valves | AISI 316 |
| Stem for gate globe valves | 13% chromium steel or Equivalent |
| Back seat | 13 % chromium steel / 13% Chrome overlay |

(4) **Gun Metal valves**

| | |
|---|---|
| Body and bonnet | IS 318 Gr. 2/ Equivalent Standard |
| Trim. | -do- |

(b) Cast iron body valves shall have high alloy steel stem and seat.

(c) Material for counter flanges shall be the same as for the piping.

(d) Forged carbon steel valves are also acceptable in place of Gun metal valves.

2.14.00 **Air Release Valve**

(a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.

(b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.

(c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass.

(d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.

2.15.00 **Butterfly valves**

2.15.01 **Design/Construction**

(a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. E-250B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter.

(b) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable

(c) Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.

(d) Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.

Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

2.15.02 **Material of Construction (Butterfly Valves)**

Materials and other design details shall be as indicated below :

(a) **Cast Iron Butterfly Valves**

| | |
|---|---|
| Body & Disc | ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated |
| Shaft | BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better. |
| Seat ring | 18-8 Stainless steel |

| | |
|---|---|
| | Seal — Nitrile Rubber |
| | (b) **Stainless Steel Butterfly Valves** |
| | Body & Disc — SS 304 |
| | Shaft — SS 316 |
| | Seat Rings — EPT/BUNA-N/Neoprene |
| | (c) **Carbon steel Butterfly Valves** |
| | Body & Disc — ASTM A 216, Gr. WCB |
| | Shaft — SS 304 |
| | Disc & Seat Rings — EPT/BUNA-N/Neoprene |
| | (d) **Elstomer lined Butterfly Valves** |
| | Body & Disc — ASTM A48, Gr. 40 / IS: 210. Gr. FG-260 / SG Iron (ductile iron) IS 1865 Gr 400-15 or BSEN 1563, Gr EN GJS-400-15 / ASTM A 216, Gr. WCB with elastomer lining. |
| | Shaft — SS 316 |
| 2.15.03 | **Proof of Design Test (Type Test) for Butterfly Valves**<br>Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder.<br>All valves that are designed and manufactured as per AWWA-C-504 / AWWA-C-516 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504/AWWA-C-516. For Butterfly valves, designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504/AWWA-C-516. |
| 2.16.00 | **Float operated valves**<br>(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.<br>(b) DESIGN AND CONSTRUCTION FEATURES<br>The following design and construction feature of the valve shall be the minimum acceptable.<br>(c) Valves shall be right-angled or globe pattern.<br>(d) Valves shall be balance piston type with float ball.<br>(e) Leather liner shall not be provided. |

(f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats.

(g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.

(h) The valves shall have flanged connections.

# SUB-SECTION-I-M9

# MDL

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0000-109-PVC-B-001 | | | GA & RCC Detail of Foundation of Reagent Feed Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 290 | 140 |
| 2 | 0000-109-PVC-B-002 | | | GA & RCC Detail of Foundation of Secondary HC Feed Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 255 | 105 |
| 3 | 0000-109-PVC-B-003 | | | GA & RCC Detail of Foundation of Filtrate water Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 283 | 133 |
| 4 | 0000-109-PVC-B-004 | | | GA & RCC Detailof Foundation of Waste water Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 290 | 140 |
| 5 | 0000-109-PVC-B-005 | | | GA & RCC Detail of Foundation of Auxilliary Storage Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 290 | 140 |
| 6 | 0000-109-PVC-B-006 | | | GA & RCC Detail of Foundation of Process Water Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 283 | 133 |
| 7 | 0000-109-PVC-B-010 | | | GGH-Layout of Piles (If applicable) - GA OF FOUNDATION & COLUMN FOR GGH SUPPORT STRUCTURE | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 292 | 142 |
| 8 | 0000-109-PVC-B-011 | | | GGH - Foundation/Pilecap & Pedestal - R/F DETAILS FOR GGH SUPPORT STRUCTURE | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 292 | 142 |
| 9 | 0000-109-PVC-B-014 | | | Pipe Rack structure- GA & RCC detail of Foundation | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Civil, | 302 | 152 |
| 10 | 0000-109-PVC-B-016 | | | GA of Foundation of Electrical equipments & control Building | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 11 | 0000-109-PVC-B-017 | | | RCC Detail of Foundation of Electrical equipments & control Building | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 12 | 0000-109-PVC-B-018 | | | GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-1 - DETAILS OF GRADE BEAMS | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 13 | 0000-109-PVC-B-018-SHT-2 | | | GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-2 - DETAILS OF LINTEN BEAMS | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 14 | 0000-109-PVC-B-018-SHT-3 | | | GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-3 - DETAILS OF FLOOR BEAMS & SLABS | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 15 | 0000-109-PVC-B-018-SHT-4 | | | GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-4 - DETAILS OF FROOF BEAMS & SLABS AT RL (+) 295.250 (TOC) | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 16 | 0000-109-PVC-B-018-SHT-5 | | | GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-5 - DETAILS OF GRADE SLAB AT RL (+) 285.800 (TOC) | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 17 | 0000-109-PVC-B-018-SHT-6 | | | GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-6 - DETAILS OF STAIR CASES & ITS BEAM UPTO ROOF | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 18 | 0000-109-PVC-B-018-SHT-7 | | | GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-7 - DETAILS OF COLUMNS | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical,PE-C&I,PE-C&I,PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 0000-109-PVC-B-019 | | | Architectural dwg of Electrical equipments & control Building | | A | D | FGD | MISCELLANEOUS | Architecture | PE-Civil,PE-Civil,PE-C&I,PE-C&I,PE-Electrical,PE-Mech/Layout,PE-Mech/SG, | 292 | 142 |
| 20 | 0000-109-PVC-B-020 | | | GA of Foundation of Gypsum Dewatering Building | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 21 | 0000-109-PVC-B-021 | | | RCC Detail of Foundation of Gypsum Dewatering Building | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 322 | 172 |
| 22 | 0000-109-PVC-B-022-SHT-1 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Grade Beams | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout,PE-Electrical, | 322 | 172 |
| 23 | 0000-109-PVC-B-022-SHT-10 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building - GA & RC Details of Lintel Beams at RL 311.2 m (BOC) | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 24 | 0000-109-PVC-B-022-SHT-2 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building : RC Details of Columns above Ground Level | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 25 | 0000-109-PVC-B-022-SHT-3 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Floor Beams & Slab at RL. 292.8 m & RL. 296.65 m | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 26 | 0000-109-PVC-B-022-SHT-4 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Floor Beams & Slab at RL. 300.65 m | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 27 | 0000-109-PVC-B-022-SHT-5 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Grade Slab | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout,PE-C&I,PE-Electrical,PE-Civil, | 322 | 172 |
| 28 | 0000-109-PVC-B-022-SHT-6 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Roof Beams & Slab | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 29 | 0000-109-PVC-B-022-SHT-7 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Lintel Beam | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 30 | 0000-109-PVC-B-022-SHT-8 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Roof Beams & Slab at RL 308.65 m | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 31 | 0000-109-PVC-B-022-SHT-9 | | | GA & RCC Detail of Superstructure of Gypsum Dewatering Building - Superstructure Stairs | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 32 | 0000-109-PVC-B-023 | | | Architectural dwg of Gypsum Dewatering Building | | A | D | FGD | MISCELLANEOUS | Architecture | PE-Civil,PE-Mech/SG,PE-Mech/Layout,PE-Electrical, | 285 | 135 |
| 33 | 0000-109-PVC-B-024 | | | GA of Foundation of Recycle Pump & Oxidation Blower Building | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/SG,PE-Electrical,PE-Mech/Layout, | 322 | 172 |
| 34 | 0000-109-PVC-B-026 | | | GA dwg of Recycle Pump & Oxidation Blower bldg Structure | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 292 | 142 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 0000-109-PVC-B-028 | | | GA of Foundation of Ball Mill Building | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 322 | 172 |
| 36 | 0000-109-PVC-B-029 | | | RCC Detail of Foundation of Ball Mill Building | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 37 | 0000-109-PVC-B-030-SHT-1 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Grade Beams | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Civil,PE-Electrical,PE-C&I, | 322 | 172 |
| 38 | 0000-109-PVC-B-030-SHT-10 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail of Side Runner | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 39 | 0000-109-PVC-B-030-SHT-11 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail Monorail Beam | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 40 | 0000-109-PVC-B-030-SHT-2 | | | GA & RCC Detail of Superstructure of Ball Mill Building : RC Details of Columns above Ground Level | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Civil, | 322 | 172 |
| 41 | 0000-109-PVC-B-030-SHT-3 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Floor Beams & Slab at RL. 292.1 m | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Civil, | 322 | 172 |
| 42 | 0000-109-PVC-B-030-SHT-4 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Floor Beams & Slab at RL. 296.76 m | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Civil, | 322 | 172 |
| 43 | 0000-109-PVC-B-030-SHT-5 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Grade Slab | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Electrical,PE-C&I,PE-Mech/SG,PE-Civil, | 322 | 172 |
| 44 | 0000-109-PVC-B-030-SHT-6 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Lintel Beams | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Civil,PE-Electrical,PE-C&I, | 322 | 172 |
| 45 | 0000-109-PVC-B-030-SHT-7 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail of Base Plate of Steel Structure | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Civil, | 322 | 172 |
| 46 | 0000-109-PVC-B-030-SHT-8 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail of Steel Superstructure | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 47 | 0000-109-PVC-B-030-SHT-9 | | | GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail of Steel Truss | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 48 | 0000-109-PVC-B-031 | | | Architectural dwg of Ball Mill Building | | A | D | FGD | MISCELLANEOUS | Architecture | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Civil,PE-Electrical, | 278 | 128 |
| 49 | 0000-109-PVC-B-032 | | | Foundations for Gypsum Bleed pump & its drive | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 278 | 128 |
| 50 | 0000-109-PVC-B-033 | | | Foundations for Oxidation Blower and its drive | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 310 | 160 |
| 51 | 0000-109-PVC-B-034 | | | GA of Foundation of Booster Fan | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 286 | 136 |
| 52 | 0000-109-PVC-B-035 | | | RCC Detail of Foundation of Booster Fan | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 286 | 136 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53 | 0000-109-PVC-B-036 | | | GA of Foundation of Ball Mill | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 313 | 163 |
| 54 | 0000-109-PVC-B-037 | | | RCC Detail of Foundation of Ball Mill | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 313 | 163 |
| 55 | 0000-109-PVC-B-038 | | | GA of Foundation of Absorber | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical,PE-Civil, | 242 | 92 |
| 56 | 0000-109-PVC-B-041 | | | GA of Foundation of Transformer | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Electrical, | 322 | 172 |
| 57 | 0000-109-PVC-B-042 | | | RCC Detail of Foundation of Transformer | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Electrical, | 322 | 172 |
| 58 | 0000-109-PVC-B-044 | | | GA & RCC Detail of Foundation of Reagent Feed Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 278 | 128 |
| 59 | 0000-109-PVC-B-045 | | | GA & RCC Detail of Foundation of Limestone Preparation Area Sump Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 278 | 128 |
| 60 | 0000-109-PVC-B-046 | | | GA & RCC Detail of Foundation of Recycle Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 244 | 94 |
| 61 | 0000-109-PVC-B-047 | | | GA & RCC Detail of Foundation of Absorber Area Sump Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 271 | 121 |
| 62 | 0000-109-PVC-B-053 | | | GA & RCC Detail of Foundation of Belt Filter Wash Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 292 | 142 |
| 63 | 0000-109-PVC-B-054 | | | GA & RCC Detail of Foundation of Dewatering Area Sump Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 278 | 128 |
| 64 | 0000-109-PVC-B-055 | | | GA & RCC Detail of Foundation of Auxiliary Storage Tank Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 278 | 128 |
| 65 | 0000-109-PVC-B-056 | | | GA & RCC Detail of Foundation of Make-up water Booster Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 271 | 121 |
| 66 | 0000-109-PVC-B-057 | | | GA & RCC Detail of Foundation of Mist Eliminator Water Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 270 | 120 |
| 67 | 0000-109-PVC-B-058 | | | GA & RCC Detail of Foundation of Process (Make-up) Water Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 264 | 114 |
| 68 | 0000-109-PVC-B-059 | | | Detail civil drawings for Road | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout, | 320 | 170 |
| 69 | 0000-109-PVC-B-060 | | | Detail civil drawings for Pavement | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 70 | 0000-109-PVC-B-061 | | | Detail civil drawings for Drains | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 322 | 172 |
| 71 | 0000-109-PVC-B-062 | | | LAYOUT OF FOUNDATION FOR FGD EQUIPMENT | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG,PE-Electrical, | 322 | 172 |
| 72 | 0000-109-PVC-B-063 | | | ABSORBER LOAD DATA | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Civil, | 322 | 172 |
| 73 | 0000-109-PVC-B-064 | | | Foundation Load Data for Auxiliary Storage Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | -, | 322 | 172 |
| 74 | 0000-109-PVC-B-065 | | | Foundation Load Data for Reagent Feed Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 75 | 0000-109-PVC-B-066 | | | Foundation Load Data for Process (Makeup) Water Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 76 | 0000-109-PVC-B-067 | | | Foundation Load Data for Waste Water Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 77 | 0000-109-PVC-B-068 | | | Foundation Load Data for Filtrate Water Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 78 | 0000-109-PVC-B-069 | | | Foundation Load Data for Secondary Hydrocyclone Feed Tank | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79 | 0000-109-PVC-B-071 | | | GA & RCC Detail of Booster Fan Outlet to GGH Duct Support Foundation | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 80 | 0000-109-PVC-B-072 | | | GA & RCC Detail of FDN for Duct Support DS 6 & DS 7 for Stack Inlet Duct | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 81 | 0000-109-PVC-B-073 | | | GA & RCC Detail of FDN for Duct Support DS 8 & DS 9 for Stack Inlet Duct | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 82 | 0000-109-PVC-B-074 | | | FDN Load Data with Base Plate & FDN Bolt Detail for DS 8&9 | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 83 | 0000-109-PVC-B-075 | | | Foundation Load Data with base Plate & Foundation Bolt Detail For GGH Support Structure | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Civil, | 322 | 172 |
| 84 | 0000-109-PVC-B-076 | | | Foundation Load Data with base Plate & Foundation Bolt Detail For Duct Support Structure DS-1 | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 85 | 0000-109-PVC-B-079 | | | Foundation Load Data with base Plate & Foundation Bolt Detail For Pipe & Cable Support Structure | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Electrical, | 322 | 172 |
| 86 | 0000-109-PVC-B-080 | | | Foundation Load Data with base Plate & Foundation Bolt Detail For Recycle Pipe Support Structure | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 87 | 0000-109-PVC-B-082 | | | GA & RCC Detail of FDN DS 1 | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 88 | 0000-109-PVC-B-083 | | | GA & RCC Detail of FDN DS 2 | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG, | 322 | 172 |
| 89 | 0000-109-PVC-B-084 | | | GA & RCC Detail of FDN DS 3 | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 90 | 0000-109-PVC-B-088 | | | Foundation Load Data of Pipe & Cable Tray Support Structure | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Electrical, | 322 | 172 |
| 91 | 0000-109-PVC-B-089 | | | GA & RCC Details of Pipe & Cable Support Foundations mkd. F3 to F5 | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Electrical,PE-Mech/Layout, | 322 | 172 |
| 92 | 0000-109-PVC-B-091 | | | Foundation Load Data with Base Plate and Anchor Bolt detail for GGH Stair | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Civil, | 322 | 172 |
| 93 | 0000-109-PVC-B-092 | | | GA & RCC Details of GGH Stair Foundation | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Civil,PE-Mech/Layout, | 322 | 172 |
| 94 | 0000-109-PVC-B-095 | | | GA & RCC Detail of External Recycle Pipe Support Foundation | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG, | 322 | 172 |
| 95 | 0000-109-PVC-B-096 | | | GA & RCC Detail of Cooling Water Pump | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG, | 322 | 172 |
| 96 | 0000-109-PVC-B-097 | | | GA & RC Details of Air Receivers | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 97 | 0000-109-PVC-B-098 | | | Detail civil drawing for sewerage system | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG,PE-Mech/Layout, | 322 | 172 |
| 98 | 0000-109-PVC-B-101 | | | FGD Chimney-General Arrangement | | A | | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout, PE-Electrical, PE-C&I | 240 | 90 |
| 99 | 0000-109-PVC-B-102 | | | FGD Chimney- Foundation Details (Main Reinforcement) | | A | | FGD | MISCELLANEOUS | PE-Civil | | 255 | 105 |
| 100 | 0000-109-PVC-B-103 | | | FGD Chimney- Foundation Details (Shell Dowels) | | A | | FGD | MISCELLANEOUS | PE-Civil | | 270 | 120 |
| 101 | 0000-109-PVC-B-104 | | | FGD Chimney- Foundation Details (Duct Pedestals) | | A | | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout | 270 | 120 |
| 102 | 0000-109-PVC-B-105 | | | FGD Chimney- Shell Profile and Details of Main Reinforcement | | A | | FGD | MISCELLANEOUS | PE-Civil | | 300 | 150 |
| 103 | 0000-109-PVC-B-106 | | | FGD Chimney- Details of Construction Openings in Shell | | A | | FGD | MISCELLANEOUS | PE-Civil | | 340 | 190 |
| 104 | 0000-109-PVC-B-107 | | | FGD Chimney- Details of Door & Miscellaneous Openings in Shell below EL (+) 10.00 M | | A | | FGD | MISCELLANEOUS | PE-Civil | PE-Electrical | 350 | 200 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105 | 0000-109-PVC-B-108 | | | FGD Chimney- Details of Openings in Shell for Ducts | | A | | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/Layout | 355 | 205 |
| 106 | 0000-109-PVC-B-109 | | | FGD Chimney- Details of Recesses in Shell for Platform No. 1 | | A | | FGD | MISCELLANEOUS | PE-Civil | | 375 | 225 |
| 107 | 0000-109-PVC-B-110 | | | FGD Chimney- Details of Recesses in Shell for Platform No. 2 | | A | | FGD | MISCELLANEOUS | PE-Civil | | 405 | 255 |
| 108 | 0000-109-PVC-B-111 | | | FGD Chimney- Details of Recesses in Shell for Platform No. 3 | | A | | FGD | MISCELLANEOUS | PE-Civil | | 415 | 265 |
| 109 | 0000-109-PVC-B-112 | | | FGD Chimney- Details of Recesses in Shell for Platform No.4 | | A | | FGD | MISCELLANEOUS | PE-Civil | | 440 | 290 |
| 110 | 0000-109-PVC-B-113 | | | FGD Chimney- Details of Air Outlet Openings in Shell below Roof | | A | | FGD | MISCELLANEOUS | PE-Civil | | 460 | 310 |
| 111 | 0000-109-PVC-B-114 | | | FGD Chimney- Details of Recesses in Shell for Roof Platform | | A | | FGD | MISCELLANEOUS | PE-Civil | | 460 | 310 |
| 112 | 0000-109-PVC-B-115 | | | FGD Chimney- Details of Roof Platform | | A | | FGD | MISCELLANEOUS | PE-Civil | | 395 | 245 |
| 113 | 0000-109-PVC-B-116 | | | FGD Chimney- Details of Platform No.4 | | A | | FGD | MISCELLANEOUS | PE-Civil | | 425 | 275 |
| 114 | 0000-109-PVC-B-117 | | | FGD Chimney- Details of Platform No. 3 | | A | | FGD | MISCELLANEOUS | PE-Civil | | 445 | 295 |
| 115 | 0000-109-PVC-B-118 | | | FGD Chimney- Details of Platform No. 2 | | A | | FGD | MISCELLANEOUS | PE-Civil | | 465 | 315 |
| 116 | 0000-109-PVC-B-119 | | | FGD Chimney- Details of Platform No. 1 | | A | | FGD | MISCELLANEOUS | PE-Civil | | 475 | 325 |
| 117 | 0000-109-PVC-B-120 | | | FGD Chimney- General Arrangement of Liner | | A | | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG | 385 | 235 |
| 118 | 0000-109-PVC-B-121 | | | FGD Chimney- Details of Liner / Can Type-A | | I | | FGD | MISCELLANEOUS | PE-Civil | | 385 | 235 |
| 119 | 0000-109-PVC-B-122 | | | FGD Chimney- Details of Liner / Can Type - F & G | | I | | FGD | MISCELLANEOUS | PE-Civil | | 435 | 285 |
| 120 | 0000-109-PVC-B-123 | | | FGD Chimney- Details of Liner / Can Type - E & H | | I | | FGD | MISCELLANEOUS | PE-Civil | | 450 | 300 |
| 121 | 0000-109-PVC-B-124 | | | FGD Chimney- Details of Liner / Can Type - B & C | | I | | FGD | MISCELLANEOUS | PE-Civil | | 455 | 305 |
| 122 | 0000-109-PVC-B-125 | | | FGD Chimney- Details of Liner / Can Type - D | | I | | FGD | MISCELLANEOUS | PE-Civil | | 480 | 330 |
| 123 | 0000-109-PVC-B-126 | | | FGD Chimney- Details of Manholes in Liners | | I | | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG | 480 | 330 |
| 124 | 0000-109-PVC-B-127 | | | FGD Chimney- Fixing Details of Liner Insulation | | I | | FGD | MISCELLANEOUS | PE-Civil | | 495 | 345 |
| 125 | 0000-109-PVC-B-128 | | | FGD Chimney- Details of Liner Support Beams and Hanger | | A | | FGD | MISCELLANEOUS | PE-Civil | | 490 | 340 |
| 126 | 0000-109-PVC-B-129 | | | FGD Chimney- Details of Liner Restraint | | A | | FGD | MISCELLANEOUS | PE-Civil | | 500 | 350 |
| 127 | 0000-109-PVC-B-130 | | | FGD Chimney- Details of Liner Expansion Joints | | A | | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG | 495 | 345 |
| 128 | 0000-109-PVC-B-131 | | | FGD Chimney- Details of Mini-Shell | | A | | FGD | MISCELLANEOUS | PE-Civil | | 540 | 390 |
| 129 | 0000-109-PVC-B-132 | | | FGD Chimney- Layout of Staircase | | I | | FGD | MISCELLANEOUS | PE-Civil | | 430 | 280 |
| 130 | 0000-109-PVC-B-133 | | | FGD Chimney- Details of Staircase | | I | | FGD | MISCELLANEOUS | PE-Civil | | 430 | 280 |
| 131 | 0000-109-PVC-B-134 | | | FGD Chimney- Details of Ladders, Hatches and other Miscellaneous Items | | I | | FGD | MISCELLANEOUS | PE-Civil | | 440 | 290 |
| 132 | 0000-109-PVC-B-135 | | | FGD Chimney- Details of Roof Slab | | A | | FGD | MISCELLANEOUS | PE-Civil | | 480 | 330 |
| 133 | 0000-109-PVC-B-136 | | | FGD Chimney- Details of Grade Level Slab | | A | | FGD | MISCELLANEOUS | PE-Civil | | 510 | 360 |
| 134 | 0000-109-PVC-B-137 | | | FGD Chimney- Scheme for Aviation Obstruction Markings | | A | | FGD | MISCELLANEOUS | PE-Civil | | 525 | 375 |
| 135 | 0000-109-PVC-B-138 | | | FGD Chimney- Layout and Details of Strakes | | A | | FGD | MISCELLANEOUS | PE-Civil | | 420 | 270 |
| 136 | 0000-109-PVC-B-139 | | | FGD Chimney-Supporting Arrangement for Gas Analyzer Panels & Details of Sampling Ports in Liner | | A | | FGD | MISCELLANEOUS | PE-Civil | PE-C&I | 540 | 390 |
| 137 | 0000-109-PVC-U-001 | | | Structural Design Basis - Civil | | A | A | FGD | MISCELLANEOUS | PE-Civil | PE-Civil,PE-Mech/SG, | 160 | 10 |
| 138 | 0000-109-PVC-U-002 | | | Civil Design Basis | | A | A | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 207 | 57 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 139 | 0000-109-PVC-U-003 | | | Design Calculation for Tank foundations | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 255 | 105 |
| 140 | 0000-109-PVC-U-010 | | | Design calculation for GGH support structure foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 272 | 122 |
| 141 | 0000-109-PVC-U-012 | | | Design calculation for Duct support foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 292 | 142 |
| 142 | 0000-109-PVC-U-014 | | | Design calculation for Pipe Rack structure foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 302 | 152 |
| 143 | 0000-109-PVC-U-016 | | | Design Calculation for Electrical equipments & control Building foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 302 | 152 |
| 144 | 0000-109-PVC-U-018 | | | Design Calculation for Electrical equipments & control Building Superstructure | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 302 | 152 |
| 145 | 0000-109-PVC-U-020 | | | Design Calculation for Gypsum Dewatering Building foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 322 | 172 |
| 146 | 0000-109-PVC-U-021 | | | Calculation Report of Dewatering Building Superstructure | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 550 | 400 |
| 147 | 0000-109-PVC-U-024 | | | Design Calculation for Recycle Pump & Oxidation Blower bldg foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 292 | 142 |
| 148 | 0000-109-PVC-U-028 | | | Design Calculation for Ball Mill Building foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 322 | 172 |
| 149 | 0000-109-PVC-U-030 | | | Calculation Report of Ball Mill Building Superstructure | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 550 | 400 |
| 150 | 0000-109-PVC-U-034 | | | Design Calculation for Booster Fan foundation | | A | D | FGD | MISCELLANEOUS | PE-Civil | -, | 286 | 136 |
| 151 | 0000-109-PVC-U-036 | | | Design Calculation for Ball Mill foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 313 | 163 |
| 152 | 0000-109-PVC-U-038 | | | Design Calculation for Absorber foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 242 | 92 |
| 153 | 0000-109-PVC-U-041 | | | Design Calculation for Transformer Foundation | | A | D | FGD | MISCELLANEOUS | PE-Civil | -, | 322 | 172 |
| 154 | 0000-109-PVC-U-042 | | | Design Calculation for Reagent Feed Pump Foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 155 | 0000-109-PVC-U-043 | | | Design Calculation for Pumps foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 156 | 0000-109-PVC-U-044 | | | Calculation Report of Waste Water Tank Foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 157 | 0000-109-PVC-U-045 | | | Calculation Report of Process (Make up) Water Tank Foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 158 | 0000-109-PVC-U-046 | | | Calculation Report of Secondary HC Feed Tank Foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 159 | 0000-109-PVC-U-047 | | | Calculation Report of Filtrate Water Tank Foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 160 | 0000-109-PVC-U-048 | | | Design Calculation of Auxiliary Storage Return Pump & Gypsum Bleed Pump | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 161 | 0000-109-PVC-U-049 | | | Design Calculation of Gypsum Bleed Pump | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 162 | 0000-109-PVC-U-070 | | | Calculation Report for Booster Fan Inlet Duct Support Foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 163 | 0000-109-PVC-U-071 | | | Calculation Report for Booster Fan Outlet to GGH Duct Support Foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 164 | 0000-109-PVC-U-083 | | | Calculation Report of Duct Support Foundation DS-2 | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 165 | 0000-109-PVC-U-084 | | | Design Calculation for Duct Support Foundation DS3 | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 166 | 0000-109-PVC-U-085 | | | Calculation of Foundation of Oxidation Blower | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 167 | 0000-109-PVC-U-086 | | | Calculation Report of GGH Stair Foundation | | I | D | FGD | MISCELLANEOUS | PE-Civil | -, | 285 | 135 |
| 168 | 0000-109-PVC-U-101 | | | FGD Chimney-Design basis report for chimney | | I | | FGD | MISCELLANEOUS | PE-Civil | | 200 | 50 |
| 169 | 0000-109-PVC-U-102 | | | FGD Chimney-Analysis and design of raft foundation for chimn | | I | | FGD | MISCELLANEOUS | PE-Civil | | 255 | 105 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 170 | 0000-109-PVC-U-103 | | | FGD Chimney-Analysis & design of RCC shell | | I | | FGD | MISCELLANEOUS | PE-Civil | | 300 | 150 |
| 171 | 0000-109-PVC-U-104 | | | FGD Chimney-Design of platform beams of Roof Platform | | I | | FGD | MISCELLANEOUS | PE-Civil | | 395 | 245 |
| 172 | 0000-109-PVC-U-105 | | | FGD Chimney-Design of platform beams of Platform No. 4 | | I | | FGD | MISCELLANEOUS | PE-Civil | | 425 | 275 |
| 173 | 0000-109-PVC-U-106 | | | FGD Chimney-Design of platform beams of Platform No. 3 | | I | | FGD | MISCELLANEOUS | PE-Civil | | 445 | 295 |
| 174 | 0000-109-PVC-U-107 | | | FGD Chimney-Design of platform beams of Platform No. 2 | | I | | FGD | MISCELLANEOUS | PE-Civil | | 465 | 315 |
| 175 | 0000-109-PVC-U-108 | | | FGD Chimney-Design of platform beams of Platform No. 1 | | I | | FGD | MISCELLANEOUS | PE-Civil | | 475 | 325 |
| 176 | 0000-109-PVC-U-109 | | | FGD Chimney-Analysis and design flue liner | | I | | FGD | MISCELLANEOUS | PE-Civil | | 385 | 235 |
| 177 | 0000-109-PVC-U-110 | | | FGD Chimney-Design of extra reinforcement around openings | | I | | FGD | MISCELLANEOUS | PE-Civil | | 350 | 200 |
| 178 | 0000-109-PVC-U-111 | | | FGD Chimney-Design of extra reinforcement around recesses f | | I | | FGD | MISCELLANEOUS | PE-Civil | | 375 | 225 |
| 179 | 0000-109-PVC-W-001 | | | Standard Details for Concrete Works | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 280 | 130 |
| 180 | 0000-109-PVC-W-002 | | | Standared Notes for Concrete Works | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Civil, | 280 | 130 |
| 181 | 0000-109-PVC-W-003 | | | Soil Investigation Report | | A | D | FGD | MISCELLANEOUS | PE-Civil | -, | 280 | 130 |
| 182 | 0000-109-PVC-W-004 | | | Location Plan ¿ Site Office, Stores & Access Road | | A | D | FGD | MISCELLANEOUS | PE-Civil | PE-Mech/SG,PE-Mech/SG,PE-Mech/Layout, | 280 | 130 |
| 183 | 0000-109-PVC-W-101 | | | FGD Chimney - wind tunnel test procedure | | A | | FGD | MISCELLANEOUS | PE-Civil | | 330 | 180 |
| 184 | 0000-109-PVC-W-102 | | | FGD Chimney - wind tunnel test report | | A | | FGD | MISCELLANEOUS | PE-Civil | | 420 | 270 |
| 185 | 0000-109-PVC-Y-101 | | | FGD Chimney- GA of expansion conpensator | | I | | FGD | MISCELLANEOUS | PE-Civil | | 510 | 360 |
| 186 | 0000-109-PVC-Y-102 | | | FGD Chimney- Datasheet for expansion conpensator | | I | | FGD | MISCELLANEOUS | PE-Civil | | 510 | 360 |
| 187 | 0000-109-PVC-Y-103 | | | FGD Chimney- Datasheet for thermal insulation | | I | | FGD | MISCELLANEOUS | PE-Civil | | 495 | 345 |
| 188 | 0000-109-PVE-B-001 | | | FGD Lighting Panel GA & Schematic and wiring drawing | | I | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 336 | 186 |
| 189 | 0000-109-PVE-B-002 | | | GA. Datasheet, Terminal Box arrangement and Curves of Slurry Recirculation pump-Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG,PE-Mech/SG, | 320 | 170 |
| 190 | 0000-109-PVE-B-003 | | | GA. Datasheet, Terminal Box arrangement and Curves of Oxidation Blower-Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG,PE-Mech/SG, | 306 | 156 |
| 191 | 0000-109-PVE-B-004 | | | GA. Datasheet, Terminal Box arrangement and Curves of BALL MILL Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG,PE-Mech/SG, | 306 | 156 |
| 192 | 0000-109-PVE-B-005 | | | GA. Datasheet, Terminal Box arrangement and Curves of Booster fan Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG,PE-Mech/SG, | 285 | 135 |
| 193 | 0000-109-PVE-B-006 | | | GA of cable tray support system | | A | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 322 | 172 |
| 194 | 0000-109-PVE-B-007 | | | GA,SLD and BOQ of DCFB | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 336 | 186 |
| 195 | 0000-109-PVE-B-008 | | | Drawing for Power Distribution Panels | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 196 | 0000-109-PVE-B-009 | | | Drawing for VFD Panels | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 197 | 0000-109-PVE-B-010 | | | Drawing for Local Starters | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 198 | 0000-109-PVE-B-011 | | | GA,SLD,Scheme and BOQ of FGD MCC | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 265 | 115 |
| 199 | 0000-109-PVE-B-012 | | | Datasheet/Drawing for Junction Box (24way, 48way, 72way, 96way) | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I,PE-Electrical, | 563 | 413 |
| 200 | 0000-109-PVE-B-013 | | | Drawing for AC Distribution Board | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 336 | 186 |
| 201 | 0000-109-PVE-B-014 | | | Drawing Local Push Button Station. | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 507 | 357 |
| 202 | 0000-109-PVE-F-001 | | | FGD MCC Control Room - Equipment and Cable Tray Layout | | A | D | FGD | MISCELLANEOUS | PE-Electrical | PE-C&I,PE-C&I,PE-Mech/WS, | 311 | 161 |
| 203 | 0000-109-PVE-F-002 | | | Earthing scheme for FGD MCC Control Room | | A | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 322 | 172 |
| 204 | 0000-109-PVE-F-003 | | | Electrical Equipment & JBs Location Layout for complete FGD Area & Limestone & Gypsum Handling area | | A | D | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/Layout,PE-Mech/MH,PE-Mech/SG,PE-Civil, | 322 | 172 |
| 205 | 0000-109-PVE-F-004 | | | Detail Cable Routing Plan for complete FGD Area & Limestone & Gypsum Handling area | | A | D | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/Layout,PE-Mech/MH,PE-Mech/SG,PE-Civil,PE-C&I, | 322 | 172 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 206 | 0000-109-PVE-F-005 | | | Illumination Layout and Road / area Lighting layout for complete FGD Area & Limestone & Gypsum Handling area | | A | D | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/Layout,PE-Mech/MH, | 322 | 172 |
| 207 | 0000-109-PVE-F-006 | | | Earthing Layout for complete FGD Area & Limestone & Gypsum Handling area | | A | D | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/Layout,PE-Mech/MH,PE-Civil,PE-Mech/SG, | 322 | 172 |
| 208 | 0000-109-PVE-F-007 | | | Lightning Protection Layout for complete FGD Area & Limestone & Gypsum Handling area | | A | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 322 | 172 |
| 209 | 0000-109-PVE-G-001 | | | Lighting Layout for FGD MCC Control Room | | I | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 285 | 135 |
| 210 | 0000-109-PVE-G-002 | | | Cable tray layout in FGD area | | A | D | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/Layout,PE-Mech/SG,PE-Mech/SG, | 311 | 161 |
| 211 | 0000-109-PVE-H-001 | | | Cable schedule for power & control cables | | I | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 297 | 147 |
| 212 | 0000-109-PVE-P-001 | | | Electrical Scope diagram | | A | A | FGD | MISCELLANEOUS | PE-Electrical | PE-C&I,PE-Mech/SG, | 160 | 10 |
| 213 | 0000-109-PVE-R-001 | | | Motor for Booster Fan - Sub QR documents of M/s Crompton Greaves Ltd., Bhopal | | A | A | FGD | MISCELLANEOUS | PE-Electrical | -, | 196 | 46 |
| 214 | 0000-109-PVE-R-002 | | | Motor for Booster Fan - Sub QR documents of M/s Weg, Hosur | | A | A | FGD | MISCELLANEOUS | PE-Electrical | -, | 196 | 46 |
| 215 | 0000-109-PVE-R-003 | | | Motor for Booster Fan - Sub QR documents of M/s Crompton Greaves Ltd., Mandideep | | A | A | FGD | MISCELLANEOUS | PE-Electrical | -, | 196 | 46 |
| 216 | 0000-109-PVE-V-001 | | | FGD Lighting Fixtures & Accessories - Mounting Details & Drawing | | I | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG,PE-Civil, | 336 | 186 |
| 217 | 0000-109-PVE-W-001 | | | Electrical load list - FGD | | I | A | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG,PE-Mech/SG, | 187 | 37 |
| 218 | 0000-109-PVE-W-002 | | | Type test reports (above 50 KW LT motors) | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 322 | 172 |
| 219 | 0000-109-PVE-W-003 | | | Type test report for Booster fan motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 322 | 172 |
| 220 | 0000-109-PVE-W-004 | | | TTR of Slurry Recirculation pump-Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 322 | 172 |
| 221 | 0000-109-PVE-W-005 | | | TTR of Oxidation Blower-Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 322 | 172 |
| 222 | 0000-109-PVE-W-006 | | | TTR of BALL MILL Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 322 | 172 |
| 223 | 0000-109-PVE-W-007 | | | FGD-Type Test Reports for Lighting Panels | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 337 | 187 |
| 224 | 0000-109-PVE-W-008 | | | FGD-Junction Boxes Type test Reports | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I,PE-Electrical, | 564 | 414 |
| 225 | 0000-109-PVE-W-009 | | | FGD-Lighting Fixtures Type Test Reports | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 337 | 187 |
| 226 | 0000-109-PVE-W-010 | | | Type test reports for Power cable | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 337 | 187 |
| 227 | 0000-109-PVE-W-011 | | | Type test reports for Control cable | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 337 | 187 |
| 228 | 0000-109-PVE-W-012 | | | Type Test Procedure for HT motors | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 285 | 135 |
| 229 | 0000-109-PVE-W-013-SHT-1 | | | Type Test Reports for FGD MCC Panels (PART 1) | | A | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 230 | 0000-109-PVE-W-013-SHT-2 | | | Type Test Reports for FGD MCC Panels (PART 2) | | A | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 231 | 0000-109-PVE-W-014 | | | Type Test Reports for Bus Duct | | A | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 232 | 0000-109-PVE-W-016 | | | Type Test Reports for Local Starters | | A | D | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 233 | 0000-109-PVE-W-018 | | | Type Test Procedure for HT Imported Motors. | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 234 | 0000-109-PVE-W-020 | | | Type test reports (90 kW LT motors- Mist Eleiminator) | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 235 | 0000-109-PVE-W-021 | | | Type test reports for Receptacles and Junction boxes | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 236 | 0000-109-PVE-W-022 | | | Type test reports (55 kW LT motors-Compressor) | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 237 | 0000-109-PVE-W-023 | | | Type test reports (75 kW & 55 kW LT motors-MH) | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 238 | 0000-109-PVE-Y-001 | | | Datasheet, GA and curves for LT Motors (FURTHER BREAK UP NECESSARY) | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG, | 164 | 14 |
| 239 | 0000-109-PVE-Y-002 | | | Datasheet for Power cable | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 337 | 187 |
| 240 | 0000-109-PVE-Y-003 | | | Datasheet for Control cable | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 337 | 187 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 241 | 0000-109-PVE-Y-004 | | | Datasheet for Control cable Additional Sizes (24Cx1.5 sqmm control cables) | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 524 | 374 |
| 242 | 0000-109-PVE-Y-005 | | | Data sheet & layout of Bus-duct | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 475 | 325 |
| 243 | 0000-109-PVE-Y-006 | | | Datasheet, GA and curves for LT Motors (Part II) - Agitator Motors | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 164 | 14 |
| 244 | 0000-109-PVE-Y-007 | | | Datasheet, GA and curves for LT Motors (Part III) ¿ GGH Main Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG, | 164 | 14 |
| 245 | 0000-109-PVE-Y-008 | | | Datasheet, GA and curves for LT Motors (Part IV) ¿ Clear water Pump Motor | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG, | 164 | 14 |
| 246 | 0000-109-PVE-Y-009 | | | Datasheet, GA and curves for LT Motors (Part V) ¿ GGH Aux. Motors | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG, | 164 | 14 |
| 247 | 0000-109-PVE-Y-010 | | | Datasheet, GA and curves for LT Motors (Part VI) ¿ GGH Aux. Motors. | | A | B | FGD | MISCELLANEOUS | PE-Electrical | PE-Mech/SG,Kuntal Bhuiyan, | 164 | 14 |
| 248 | 0000-109-PVE-Y-011 | | | Datasheet, GA and curves for LT Motors (Part VII) ¿ MH Motors | | A | B | FGD | MISCELLANEOUS | PE-Electrical | Kuntal Bhuiyan,PE-Mech/MH, | 164 | 14 |
| 249 | 0000-109-PVE-Y-020 | | | Datasheet for Power cable of Additional Sizes (3.5Cx50 sqmm power cables) | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 524 | 374 |
| 250 | 0000-109-PVE-Y-050 | | | Datasheet for Earthing & Lightning Materials | | A | B | FGD | MISCELLANEOUS | PE-Electrical | -, | 524 | 374 |
| 251 | 0000-109-PVI-B-001 | | | GA, BOQ & Data sheets for PLC Panels | | I | B | FGD | MISCELLANEOUS | PE-C&I | -, | 322 | 172 |
| 252 | 0000-109-PVI-B-002 | | | PLC Power supply and earthing scheme drawing | | I | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I,PE-Electrical, | 322 | 172 |
| 253 | 0000-109-PVI-B-003 | | | PLC Module wiring diagram | | I | B | FGD | MISCELLANEOUS | PE-C&I | -, | 322 | 172 |
| 254 | 0000-109-PVI-B-004 | | | Drawing & Datasheet of Rotameter | | I | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 164 | 14 |
| 255 | 0000-109-PVI-B-005 | | | Drawing & Datasheet of LIE/LIR | | I | B | FGD | MISCELLANEOUS | PE-C&I | -, | 164 | 14 |
| 256 | 0000-109-PVI-B-006 | | | Drawing & datasheet of Radar type Level Transmitter (for Silo) | | I | B | FGD | MISCELLANEOUS | PE-C&I | -, | 164 | 14 |
| 257 | 0000-109-PVI-B-007 | | | GA, Datasheet and Wiring diagram of Lime Dosing Local Control Panel | | I | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I,PE-Electrical, | 164 | 14 |
| 258 | 0000-109-PVI-B-008 | | | GA and Wiring Oxidation Blower Local Control Panel | | I | B | FGD | MISCELLANEOUS | PE-Electrical | PE-C&I,Kuntal Bhuiyan, | 164 | 14 |
| 259 | 0000-109-PVI-B-009 | | | GA and Wiring Diagram Drawing for GGH-Multimedia Cleaner PLC Panel | | I | B | FGD | MISCELLANEOUS | PE-C&I | PE-Electrical, | 164 | 14 |
| 260 | 0000-109-PVI-F-001 | | | Electronic Earthing Layout Drawing for FGD Control Room | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-Electrical, | 257 | 107 |
| 261 | 0000-109-PVI-G-001 | | | Instrument list | | I | A | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 194 | 44 |
| 262 | 0000-109-PVI-G-002 | | | I/O List | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 257 | 107 |
| 263 | 0000-109-PVI-G-003 | | | Drive List | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 257 | 107 |
| 264 | 0000-109-PVI-G-004 | | | Alarm & Trip Set Point List | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 257 | 107 |
| 265 | 0000-109-PVI-H-001 | | | Cable Schedule for power, control & instrument cables. | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 297 | 147 |
| 266 | 0000-109-PVI-P-001 | | | Control system configuration diagrams and Write up | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 235 | 85 |
| 267 | 0000-109-PVI-P-002 | | | Interfacing and connectivity diagram with the Employer system | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 264 | 114 |
| 268 | 0000-109-PVI-P-009 | | | CONTROL SYSTEM ARCHITECTURE of FGD System | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-Mech/SG, | 265 | 115 |
| 269 | 0000-109-PVI-Q-001 | | | Installation Scheme, Instrument wiring and tubing diagrams (hook up) | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 322 | 172 |
| 270 | 0000-109-PVI-T-001 | | | Block logic diagrams with Sequence and protection interlock schemes | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 272 | 122 |
| 271 | 0000-109-PVI-T-002 | | | Logic Diagram for Sequence and Interlocking (AS IMPLEMENTED IN PLC) | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 272 | 122 |
| 272 | 0000-109-PVI-U-007 | | | Document for Sizing of UPS and Battery | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 166 | 16 |
| 273 | 0000-109-PVI-U-008 | | | Document for Sizing of charger and Battery | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 164 | 14 |
| 274 | 0000-109-PVI-V-001 | | | PLC Graphics and Mimics | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 164 | 14 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 275 | 0000-109-PVI-V-002 | | | PLC Hardware design specification | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 164 | 14 |
| 276 | 0000-109-PVI-V-003 | | | PLC software design specification | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 164 | 14 |
| 277 | 0000-109-PVI-W-001 | | | ATST Procedure - FGD System | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 268 | 118 |
| 278 | 0000-109-PVI-W-003 | | | Type Test Report of PLC System | | I | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 322 | 172 |
| 279 | 0000-109-PVI-W-004 | | | Type Test Report of Battery and Charger | | A | B | FGD | MISCELLANEOUS | PE-C&I | -, | 514 | 364 |
| 280 | 0000-109-PVI-W-006 | | | Cable list of UPS and Charger | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 315 | 165 |
| 281 | 0000-109-PVI-W-007 | | | Type Test report for Cable | | I | B | FGD | MISCELLANEOUS | PE-C&I | -, | 531 | 381 |
| 282 | 0000-109-PVI-W-008 | | | FUNCTION CONTROL DESCRIPTION FOR FLUE GAS PATH SYSTEM | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/SG,PE-Mech/SG, | 285 | 135 |
| 283 | 0000-109-PVI-W-009 | | | FUNCTION CONTROL DESCRIPTION FOR ABOSRBER / OXIDATION BLOWER SYSTEM | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-C&I,PE-Mech/SG,PE-Mech/SG, | 285 | 135 |
| 284 | 0000-109-PVI-W-010 | | | FUNCTION CONTROL DESCRIPTION FOR LIMESTONE PREPARATION | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/SG, | 285 | 135 |
| 285 | 0000-109-PVI-W-011 | | | FUNCTION CONTROL DESCRIPTION FOR PRIMARY DEWATERING | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-C&I,PE-Mech/SG,PE-Mech/SG, | 285 | 135 |
| 286 | 0000-109-PVI-W-012 | | | FUNCTION CONTROL DESCRIPTION FOR SUMP PUMPS | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-C&I,PE-Mech/SG,PE-C&I, | 285 | 135 |
| 287 | 0000-109-PVI-W-013 | | | FUNCTION CONTROL DESCRIPTION FOR GYPSUM CONVEYORS | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/MH,PE-Mech/MH, | 285 | 135 |
| 288 | 0000-109-PVI-W-014 | | | Functional Control Description of Secondary Dewatering System | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-C&I,PE-Mech/SG,PE-Mech/SG, | 285 | 135 |
| 289 | 0000-109-PVI-W-015 | | | Functional Control Description of Process & Cooling Water System | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/SG, | 285 | 135 |
| 290 | 0000-109-PVI-W-016 | | | Functional Control Description of Belt Filter | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-C&I,PE-Mech/SG,PE-Mech/SG,PE-Mech/MH, | 285 | 135 |
| 291 | 0000-109-PVI-W-017 | | | FCD for Overview Control Description | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 285 | 135 |
| 292 | 0000-109-PVI-W-018 | | | Mandatory Spare List for Instruments | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 285 | 135 |
| 293 | 0000-109-PVI-W-019 | | | Logic diagram of FGD interface with boiler such as Booster Fan Blade Pitch Control, FGD bypass damper control, FGD Inlet and outlet gate control (Interlock & Control) | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-Mech/SG, | 285 | 135 |
| 294 | 0000-109-PVI-W-020 | | | FCD for Limestone Handling System | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/MH, | 285 | 135 |
| 295 | 0000-109-PVI-W-021 | | | LIE/LIR & JB Grouping | | I | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 285 | 135 |
| 296 | 0000-109-PVI-W-022 | | | Instruments location drawing/layout | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 285 | 135 |
| 297 | 0000-109-PVI-W-023 | | | Pre-ATST report-FGD system | | I | D | FGD | MISCELLANEOUS | PE-C&I | -, | 285 | 135 |
| 298 | 0000-109-PVI-Y-001 | | | Data sheets for Instrumentation and control Cable. | | A | B | FGD | MISCELLANEOUS | PE-C&I | -, | 531 | 381 |
| 299 | 0000-109-PVI-Y-007 | | | Data sheets for UPS, Sizing of UPS and Battery | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 317 | 167 |
| 300 | 0000-109-PVI-Y-008 | | | Data sheets for Battery Charger and sizing of charger and Battery | | A | B | FGD | MISCELLANEOUS | PE-C&I | -, | 507 | 357 |
| 301 | 0000-109-PVI-Y-009 | | | Data Sheet/Drawing for SO2 Analyser | | A | B | FGD | MISCELLANEOUS | PE-C&I | -, | 455 | 305 |
| 302 | 0000-109-PVI-Y-010 | | | Data Sheet/Drawing for pH Analyser | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 455 | 305 |
| 303 | 0000-109-PVI-Y-011 | | | Datasheet/Drawing for Junction Box | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 337 | 187 |
| 304 | 0000-109-PVI-Y-012 | | | Data Sheet of Operator Desk and Computer furniture | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 322 | 172 |
| 305 | 0000-109-PVI-Y-013 | | | Datasheet for Optical Fiber Cable | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 337 | 187 |
| 306 | 0000-109-PVI-Y-014 | | | Datasheet/Drawing for RTD -TT- JB | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 337 | 187 |
| 307 | 0000-109-PVI-Y-015 | | | Datasheet of Electronic Transmitter | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 303 | 153 |
| 308 | 0000-109-PVI-Y-016 | | | Datasheet & GA Drawing of Pressure Gauge, Chemical Seal Pressure Gauge | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 309 | 0000-109-PVI-Y-017 | | | Datasheet & GA Drawing of Temperature Gauge | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 310 | 0000-109-PVI-Y-018 | | | Datasheet & GA Drawing of Level Gauge with scale & Reflex type Level Gauge | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 311 | 0000-109-PVI-Y-019 | | | Datasheet & GA Drawing of Pressure Switch & DP Switch | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 312 | 0000-109-PVI-Y-020 | | | Datasheet & GA Drawing of RTD with Thermowell | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 313 | 0000-109-PVI-Y-021 | | | Datasheet & GA Drawing of Pressure Transmitter & Chemical Seal Pressure Transmitter | | A | B | FGD | MISCELLANEOUS | PE-C&I | -, | 508 | 358 |
| 314 | 0000-109-PVI-Y-022 | | | Datasheet & GA Drawing of Temperature Transmitter | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 315 | 0000-109-PVI-Y-023 | | | Datasheet & GA Drawing of Ultrasonic Level Transmitter | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 316 | 0000-109-PVI-Y-024 | | | Datasheet & GA Drawing of DP type Level Transmitter | | A | B | FGD | MISCELLANEOUS | PE-C&I | -, | 508 | 358 |
| 317 | 0000-109-PVI-Y-025 | | | Datasheet & GA Drawing of Magnetic Flow Meter | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 318 | 0000-109-PVI-Y-026 | | | Datasheet & GA Drawing of Coriolis Density Meter | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 319 | 0000-109-PVI-Y-027 | | | Datasheet & GA Drawing of DP type Flow Transmitter for Water | | A | B | FGD | MISCELLANEOUS | PE-C&I | -, | 508 | 358 |
| 320 | 0000-109-PVI-Y-028 | | | Datasheet & GA Drawing of DP type Flow Transmitter for Flue Gas & Air | | A | B | FGD | MISCELLANEOUS | PE-C&I | -, | 508 | 358 |
| 321 | 0000-109-PVI-Y-029 | | | Datasheet & GA Drawing of Vibration Transmitter | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 322 | 0000-109-PVI-Y-030 | | | Datasheet & GA Drawing of GI Conduit | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 323 | 0000-109-PVI-Y-031 | | | Drawing and Datasheet for Universal HART Communicator | | A | B | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 324 | 0000-109-PVI-Y-032 | | | DATA SHEET / BOM / GA / SCHEMATIC / SAMPLING DRG FOR SOX/NOX/CO2/CO ANALYZERS AND ASSOCIATED SYSTEM OF CEMS | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 325 | 0000-109-PVI-Y-033 | | | DATA SHEET / BOM / GA / SCHEMATIC / SAMPLING DRG FOR DUST DENSITY/SPM ANALYSER AND ASSOCIATED SYSTEM OF CEMS | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 326 | 0000-109-PVI-Y-034 | | | DATA SHEET / BOM / GA / SCHEMATIC / SAMPLING DRG FOR MERCURY ANALYSER AND ASSOCIATED SYSTEM OF CEMS | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 327 | 0000-109-PVI-Y-035 | | | DATA SHEET / BOM / GA / SCHEMATIC / SAMPLING DRG FOR FLUE GAS FLOWMETER AND ASSOCIATED SYSTEM OF CEMS | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 328 | 0000-109-PVI-Y-036 | | | SCHEMATIC DRAWING SHOWING INTERFACING OF CEMS ANALYSERS WITH DDCMIS AND CLOUD SERVER | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 329 | 0000-109-PVI-Y-037 | | | GA OF CHIMNEY INDICAING SAMPLING PORT/ TAPPINGS FOR FLUE GAS ANALYSERS (CEMS MEASUREMENTS) | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 330 | 0000-109-PVI-Y-038 | | | Commissioning procedure/manual for CEMS. | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 331 | 0000-109-PVI-Y-039 | | | O&M manual for CEMS. | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 332 | 0000-109-PVI-Y-040 | | | Erection drawing including erection procedure for CEMS | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 333 | 0000-109-PVI-Y-041 | | | Datasheet of analyser for ZLD system | | A | D | FGD | MISCELLANEOUS | PE-C&I | PE-C&I, | 508 | 358 |
| 334 | 0000-109-PVM-B-001 | | | General Arrangement drawing of Elevator | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 272 | 122 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 335 | 0000-109-PVM-B-002 | | | General Arrangement & Data Sheet of Mill Hydro Cyclone | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Civil, | 308 | 158 |
| 336 | 0000-109-PVM-B-003 | | | General Arrangement of Mill circuit Tank | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-C&I,PE-Civil, | 317 | 167 |
| 337 | 0000-109-PVM-B-004 | | | General Arrangement of Limestone Pulverizer(Wet ball Mill) | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 259 | 109 |
| 338 | 0000-109-PVM-B-005 | | | General Arrangement for Cake wash Water Tank | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 257 | 107 |
| 339 | 0000-109-PVM-B-006 | | | General Arrangement for Cake wash Pump | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I,PE-Electrical, | 257 | 107 |
| 340 | 0000-109-PVM-B-009 | | | General Arrangement of GGH and Its auxiliries | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Civil, | 237 | 87 |
| 341 | 0000-109-PVM-B-010 | | | General Arrangement for Absorber | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Civil,PE-Electrical, | 181 | 31 |
| 342 | 0000-109-PVM-B-011 | | | General Arrangement for Slurry Recirculation Pumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 230 | 80 |
| 343 | 0000-109-PVM-B-012 | | | General Arrangement for Oxidation Air Blower | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 251 | 101 |
| 344 | 0000-109-PVM-B-013 | | | General Arrangement for Gypsum Dewatering Pump(Gypsum Bleed Pump) | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 250 | 100 |
| 345 | 0000-109-PVM-B-014 | | | General Arrangement for Limestone slurry pumps | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 250 | 100 |
| 346 | 0000-109-PVM-B-015 | | | General Arrangement of Limestone slurry storage tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 217 | 67 |
| 347 | 0000-109-PVM-B-016 | | | General Arrangement of Secondary Hydro-cyclone Feed Tank | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 217 | 67 |
| 348 | 0000-109-PVM-B-017 | | | General Arrangement of Secondary Hydro-cyclone Pumps | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 264 | 114 |
| 349 | 0000-109-PVM-B-018 | | | General Arrangement & Data Sheet of Mill Recycle Pump | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 308 | 158 |
| 350 | 0000-109-PVM-B-020 | | | GA of Primary Dewaterng Hydorcyclone | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Civil, | 250 | 100 |
| 351 | 0000-109-PVM-B-021 | | | General Arrangement of Limestone Day Silos | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Civil,PE-Mech/MH,PE-Mech/MH, | 292 | 142 |
| 352 | 0000-109-PVM-B-022 | | | General Arrangement of Vacuum Belt filters | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Mech/MH,PE-Mech/MH,PE-Electrical, | 268 | 118 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 353 | 0000-109-PVM-B-023 | | | General Arrangement of Filtrate Water Tank | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 217 | 67 |
| 354 | 0000-109-PVM-B-024 | | | General Arrangement of Filtrate Water Pumps | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 257 | 107 |
| 355 | 0000-109-PVM-B-025 | | | General Arrangement OF Emergency Quench Water Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 224 | 74 |
| 356 | 0000-109-PVM-B-026 | | | General Arrangement of Secondary Hydrocyclone | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Civil, | 250 | 100 |
| 357 | 0000-109-PVM-B-027 | | | General Arrangement of Waste Water Tank | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 217 | 67 |
| 358 | 0000-109-PVM-B-028 | | | General Arrangement of Waste Water Pumps | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 264 | 114 |
| 359 | 0000-109-PVM-B-029 | | | General Arrangement of Process (Make up) Water Tank | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 217 | 67 |
| 360 | 0000-109-PVM-B-030 | | | General Arrangement of Water Pump | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Civil,PE-Electrical, | 243 | 93 |
| 361 | 0000-109-PVM-B-031 | | | General Arrangement of Auxiliary Absorbent (Storage) Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 224 | 74 |
| 362 | 0000-109-PVM-B-032 | | | General Arrangement of Auxiliary Absorbent (Storage Return) Pump | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 250 | 100 |
| 363 | 0000-109-PVM-B-033 | | | General Arrangement of Expansion Joints | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 269 | 119 |
| 364 | 0000-109-PVM-B-034 | | | General Arrangement of Agitator for Absorber Reaction Tank | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I,PE-Electrical, | 308 | 158 |
| 365 | 0000-109-PVM-B-035 | | | General Arrangement Bag Filter for Limestone Day Silos | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 278 | 128 |
| 366 | 0000-109-PVM-B-036 | | | Arrangement of Stairs and Platforms - Absorber | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil, | 236 | 86 |
| 367 | 0000-109-PVM-B-037 | | | General Arrangement for Booster fan | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I, | 223 | 73 |
| 368 | 0000-109-PVM-B-038 | | | GA & Datasheet for Pipe Expansion Joint | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 551 | 401 |
| 369 | 0000-109-PVM-B-042 | | | GA of Instrument air receiver | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I,PE-Mech/WS, | 306 | 156 |
| 370 | 0000-109-PVM-B-043 | | | GA of Service air receiver | | I | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I,PE-Mech/WS, | 306 | 156 |
| 371 | 0000-109-PVM-B-045 | | | General arrangement of Recycle Pump & Oxidation Blower Building | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-C&I,PE-Civil,PE-Electrical,Architecture, | 265 | 115 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 372 | 0000-109-PVM-B-046 | | | General arrangement of Dewatering building | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical,Architecture,PE-Mech/WS, | 258 | 108 |
| 373 | 0000-109-PVM-B-047 | | | General arrangement of Ball Mill Building | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical,Architecture,PE-Mech/WS,PE-Civil,PE-C&I, | 271 | 121 |
| 374 | 0000-109-PVM-B-049 | | | General Layout of FGD Ducting | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Civil, | 322 | 172 |
| 375 | 0000-109-PVM-B-050 | | | General Layout of Pipe rack/trestle & Cable ways | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil,PE-Electrical, | 292 | 142 |
| 376 | 0000-109-PVM-B-056 | | | General Arrangement & Data sheet of Waste Water Tank Agitator | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 377 | 0000-109-PVM-B-057 | | | General Arrangement & Data Sheet of Mill Tank Agitator | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 378 | 0000-109-PVM-B-058 | | | General Arrangement & Data Sheet of Limestone Weigh Feeder | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/MH,PE-C&I, | 292 | 142 |
| 379 | 0000-109-PVM-B-059 | | | Documents for Seal Air System of Guillotine Damper | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I, | 292 | 142 |
| 380 | 0000-109-PVM-B-060 | | | GA & Data Sheet for Air Cannon | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I, | 292 | 142 |
| 381 | 0000-109-PVM-B-066 | | | GA & Data Sheet for Butterfly Valves | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/MH,PE-C&I,PE-Electrical, | 292 | 142 |
| 382 | 0000-109-PVM-B-067 | | | GA & Data Sheet for GLOBE VALVES | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 383 | 0000-109-PVM-B-068 | | | GA & Data Sheet for BALL VALVES | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I, | 292 | 142 |
| 384 | 0000-109-PVM-B-069 | | | GA & Data Sheet for GATE VALVES | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 385 | 0000-109-PVM-B-070 | | | GA & Data Sheet for CHECK VALVES | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/MH, | 292 | 142 |
| 386 | 0000-109-PVM-B-071 | | | GA & Data sheet for Control Valves (including ceramic ball control valves) | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/MH,PE-C&I,PE-Electrical, | 292 | 142 |
| 387 | 0000-109-PVM-B-072 | | | GA Drawing & Datasheet of 12T Hoist for Ball Mill Building | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 292 | 142 |
| 388 | 0000-109-PVM-B-073 | | | GA & Datasheet of 25T Hoist | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical,PE-Mech/MH, | 292 | 142 |
| 389 | 0000-109-PVM-B-074 | | | GA & Datasheet of Condensate System of Chimney | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/WS | 306 | 156 |
| 390 | 0000-109-PVM-F-001 | | | P&ID- Flue Gas Ducting and Dampers System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 391 | 0000-109-PVM-F-002 | | | P&ID- Booster fan Lube oil system | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 392 | 0000-109-PVM-F-003 | | | P&ID - GGH and its auxiliaries | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 393 | 0000-109-PVM-F-004 | | | P&ID - Absorber | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 394 | 0000-109-PVM-F-005 | | | P&ID - Recycle Pumps | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 395 | 0000-109-PVM-F-006 | | | P&ID - Gypsum Bleed Pumps | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 396 | 0000-109-PVM-F-007 | | | P&ID - Mist Eliminator Wash Water System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 397 | 0000-109-PVM-F-008 | | | P&ID - Absorber area Sumps | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 398 | 0000-109-PVM-F-009 | | | P&ID - Auxiliary Storage Tank & Pumps | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 399 | 0000-109-PVM-F-010 | | | P&ID - Oxidation Air Blower system | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 400 | 0000-109-PVM-F-011 | | | P&ID - Primary Dewatering System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 401 | 0000-109-PVM-F-012 | | | P&ID - Dewatering area sump & pump | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 402 | 0000-109-PVM-F-013 | | | P&ID - Secondary Dewatering System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-Mech/MH,PE-C&I, | 199 | 49 |
| 403 | 0000-109-PVM-F-014 | | | P&ID - Waste Water Discharge System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 404 | 0000-109-PVM-F-015 | | | P&ID - Filtrate Water System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 405 | 0000-109-PVM-F-016 | | | P&ID - Limestone Silo | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 406 | 0000-109-PVM-F-017 | | | P&ID - Reagent Preparation System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 407 | 0000-109-PVM-F-018 | | | P&ID - Reagent Feed Tank and Pumps | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 408 | 0000-109-PVM-F-019 | | | P&ID - Reagent Preparation area Sump & Pump | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 409 | 0000-109-PVM-F-020 | | | P&ID - Make up Water Booster Pumps | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 410 | 0000-109-PVM-F-021 | | | P&ID - Process (Make up) Water Tank & Pumps | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 411 | 0000-109-PVM-F-022 | | | P&ID - Emergency Quench system | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 412 | 0000-109-PVM-F-023 | | | P&ID - Water Distribution | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 413 | 0000-109-PVM-F-024 | | | P&ID - Air Distribution | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 414 | 0000-109-PVM-F-025 | | | P&ID - Legends & Notes | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 415 | 0000-109-PVM-F-026 | | | P&ID - Neutralisation Tank | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 416 | 0000-109-PVM-F-027 | | | P&ID - Cooling Water Distribution | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 417 | 0000-109-PVM-F-028 | | | P&ID - Oxidation Blower | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 418 | 0000-109-PVM-F-029 | | | P&ID of Vacuum Belt filter & Primary Hydrocyclone | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 419 | 0000-109-PVM-F-030 | | | P&ID for Limestone Pulverizer-Wet Ball Mill Lubrication system | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 420 | 0000-109-PVM-F-031 | | | P&ID for Compressed Air System for Bag Filter Pulsing | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 199 | 49 |
| 421 | 0000-109-PVM-F-044 | | | Plant Layout of FGD System - Sheet 1 | | A | - | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Civil,PE-Mech/Layout,PE-C&I,PE-Electrical,PE-Mech/SG,PE-Mech/MH,PE-Mech/MH,PE-Civil, | 160 | 10 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 422 | 0000-109-PVM-F-045 | | | Plant Layout of FGD System - Sheet 2 | | A | - | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Civil,PE-Mech/Layout,PE-C&I,PE-Electrical,PE-Mech/SG,PE-Civil,PE-Mech/MH,PE-Mech/MH, | 160 | 10 |
| 423 | 0000-109-PVM-H-001 | | | Painting schedule of FGD System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Civil,PE-Civil,PE-Mech/MH,PE-Electrical, | 222 | 72 |
| 424 | 0000-109-PVM-H-002 | | | Valve Schedules | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical, | 271 | 121 |
| 425 | 0000-109-PVM-H-003 | | | Pipe Schedule | | I | D | FGD | MISCELLANEOUS | PE-MECH | PE-Mech/SG,PE-C&I,PE-Electrical, | 292 | 142 |
| 426 | 0000-109-PVM-H-004 | | | Insulation Schedule | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 272 | 122 |
| 427 | 0000-109-PVM-H-005 | | | Expansion Joint Schedule | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 272 | 122 |
| 428 | 0000-109-PVM-L-001 | | | Process Flow Diagram of FGD System | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I, | 160 | 10 |
| 429 | 0000-109-PVM-L-038 | | | General Arrangement for Piping - FGD area (Absorber, Recycle Pump, GGH & Aux storage tank area etc) | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil, | 292 | 142 |
| 430 | 0000-109-PVM-L-039 | | | General Arrangement for Piping - Lime Preparation Area (Ball Mill & Lime handling area etc) | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil, | 292 | 142 |
| 431 | 0000-109-PVM-L-040 | | | General Arrangement for Piping - Dewatering area (Beltfilter and Hydrocyclone area etc) | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/Layout,PE-Civil, | 290 | 140 |
| 432 | 0000-109-PVM-N-001 | | | Performance Curve for BOOSTER FANS | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 223 | 73 |
| 433 | 0000-109-PVM-R-002 | | | Oxidation Blower - Sub QR documents of M/s ITO, Japan | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 434 | 0000-109-PVM-R-004 | | | Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Thysencrupp, Germany | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 435 | 0000-109-PVM-R-005 | | | Recirculation Slurry Pump - Sub QR documents of M/s DUCHTING PUMPEN, GERMANY | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 436 | 0000-109-PVM-R-006 | | | Booster Fan - Sub QR documents of M/s Solyvent Flakt AB, Sweden | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 437 | 0000-109-PVM-R-007 | | | Slurry Pump - Sub QR documents of M/s Duchting Pumpen, Germany | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 438 | 0000-109-PVM-R-008 | | | Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Metso, USA | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 439 | 0000-109-PVM-R-009 | | | Agitators - Sub QR documents of M/s EKATO RMT GMBH. Germany | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 440 | 0000-109-PVM-R-010 | | | Vaccume Belt Filters - Sub QR documents of M/s Shanghai Xuhe Environmental Technology Co. Ltd., Shanghai, China | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 441 | 0000-109-PVM-R-012 | | | Vaccume Belt Filters - Sub QR documents of M/s FLSmidth, USA | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 442 | 0000-109-PVM-R-013 | | | Agitators - Sub QR documents of M/s Zhejiang Greatwall Reducer Mfg Co. Ltd. | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 443 | 0000-109-PVM-R-014 | | | Gas to Gas Heat Exchanger (GGH) - Sub QR documents | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 444 | 0000-109-PVM-R-015 | | | Slurry Pump - Sub QR documents of M/s Weir Minerals, USA | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 445 | 0000-109-PVM-R-016 | | | Slurry Pump - Sub QR documents of M/s Sam Turbo Industries Pvt. Ltd., Koimbatoor | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 446 | 0000-109-PVM-R-017 | | | Booster Fan - Sub QR documents of M/s Suewon Poongryuk Machinery Co. Ltd, Korea | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 447 | 0000-109-PVM-R-018 | | | Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Cemtec, Austria | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 448 | 0000-109-PVM-R-019 | | | Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Christian Pfeiffer Maschinenfabrik¿ Austria | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 449 | 0000-109-PVM-R-020 | | | Oxidation Air Blower - Sub QR documents of /s Siemens Turbo Machinery / HV Turbo | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 450 | 0000-109-PVM-U-001 | | | FGD System Design Basis - PROCESS | | A | - | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 160 | 10 |
| 451 | 0000-109-PVM-U-002 | | | Flue gas system design and Duct Sizing Calculation | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 187 | 37 |
| 452 | 0000-109-PVM-U-003 | | | ABSORBER DESIGN BASIS | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 181 | 31 |
| 453 | 0000-109-PVM-U-004 | | | Sizing Calculation & Selection parameter for GGH | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 223 | 73 |
| 454 | 0000-109-PVM-U-005 | | | Sizing Calculation & Selection parameter for Slurry Recirculation Pumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 223 | 73 |
| 455 | 0000-109-PVM-U-006 | | | Sizing Calculation & Selection parameter for Oxidation Air Blower | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 251 | 101 |
| 456 | 0000-109-PVM-U-007 | | | Sizing Calculation& Selection paramete for Emergency Quench Water System | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 457 | 0000-109-PVM-U-008 | | | Sizing Calculation & Selection parameter for all slurry pumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 264 | 114 |
| 458 | 0000-109-PVM-U-009 | | | Sizing Calculation & Selection parameter for all slurry tanks | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 459 | 0000-109-PVM-U-011 | | | Sizing Calculation& Selection parameter for Wet ball Mill including Motor sizing calculation for Ball Mill | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 315 | 165 |
| 460 | 0000-109-PVM-U-012 | | | Sizing Calculation & Selection parameter for Vacuum Belt filters | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 237 | 87 |
| 461 | 0000-109-PVM-U-014 | | | Sizing Calculation & Selection parameter for all Water Pump | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 257 | 107 |
| 462 | 0000-109-PVM-U-015 | | | Sizing Calculation of Limestone day silo | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 195 | 45 |
| 463 | 0000-109-PVM-U-016 | | | Sizing Calculation & Selection parameter for BOOSTER FANS | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 223 | 73 |
| 464 | 0000-109-PVM-U-017 | | | Sizing Calculation & Selection parameter for Sump pumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 263 | 113 |
| 465 | 0000-109-PVM-U-018 | | | Sizing calculation of Instrument air receiver | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 171 | 21 |
| 466 | 0000-109-PVM-U-019 | | | Sizing calculation of Service air receiver | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 171 | 21 |
| 467 | 0000-109-PVM-U-020 | | | FGD System Design Basis -MECHANICAL | | I | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 202 | 52 |
| 468 | 0000-109-PVM-U-021 | | | Sizing Calculation for Secondary Hydro-cyclone | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 250 | 100 |
| 469 | 0000-109-PVM-U-022 | | | Design basis (Heat load calculation) for HVAC system | | A | D | FGD | MISCELLANEOUS | PE-Mech/WS | PE-Mech/SG,PE-Mech/SG, | 292 | 142 |
| 470 | 0000-109-PVM-U-024 | | | Sizing Calculation& Selection parameter for Limestone Pulverizer(Wet ball Mill) auxiliaries | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 315 | 165 |
| 471 | 0000-109-PVM-U-027 | | | Structural Design Basis - Mechanical (Ducts, Silos, Tanks) | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | -, | 160 | 10 |
| 472 | 0000-109-PVM-U-028 | | | DESIGN CRITERIA OF ABSORBER TOWER | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 160 | 10 |
| 473 | 0000-109-PVM-U-029 | | | Quench Sizing Calculation & Selection Parameter | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 160 | 10 |
| 474 | 0000-109-PVM-U-030 | | | Condensate Study for Low Height Chimney | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 230 | 80 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 475 | 0000-109-PVM-W-001 | | | Selection of Material and Application Procedure for FGD plant | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 196 | 46 |
| 476 | 0000-109-PVM-W-002 | | | Mass Flow Balance (Design Points) data | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 160 | 10 |
| 477 | 0000-109-PVM-W-003 | | | Mass Flow Balance (Guarantee Points) data | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 160 | 10 |
| 478 | 0000-109-PVM-W-005 | | | Write-up on & Selection of valves for slurry application | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 186 | 36 |
| 479 | 0000-109-PVM-W-006 | | | Requirements of Instrument air, Service air, Auxiliary steam, Equipment cooling water, etc.. (Utility List) | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/WS,Navneet Kumar,Nipun Pharlia,Apurva Srivastava, | 271 | 121 |
| 480 | 0000-109-PVM-W-008 | | | Predicted Performance of FGD System at a) Design Point & b) Guarantee point | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 340 | 190 |
| 481 | 0000-109-PVM-W-010 | | | Performance test procedure | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 340 | 190 |
| 482 | 0000-109-PVM-W-011 | | | Type test procedure for Gates & Dampers | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 271 | 121 |
| 483 | 0000-109-PVM-W-012 | | | Type Test Performance Procedure for BOOSTER FANS | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 230 | 80 |
| 484 | 0000-109-PVM-W-013 | | | Type Test Performance Report for BOOSTER FANS | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 250 | 100 |
| 485 | 0000-109-PVM-W-014 | | | Surface preparation & application procedure for Flake glass lining | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 486 | 0000-109-PVM-W-015 | | | Surface preparation & application procedure for Rubber lining | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 487 | 0000-109-PVM-W-016 | | | Leak tightness performance test Report of damper/gates | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 488 | 0000-109-PVM-W-017 | | | Battery Limits- FGD (to take care all interfaces points among NTPC & Vendor WITH all detail views at terminal points) | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-Electrical,PE-Mech/Layout,Navneet Kumar, | 292 | 142 |
| 489 | 0000-109-PVM-W-018 | | | DOCUMENT FOR COLOUR CODING STANDARD | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-Mech/MH, | 292 | 142 |
| 490 | 0000-109-PVM-W-019 | | | DOCUMENT FOR Type Test Report of Dampers | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 491 | 0000-109-PVM-W-020 | | | Write up on Equipment Handling | | I | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 292 | 142 |
| 492 | 0000-109-PVM-X-001 | | | O & M MANUAL | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-C&I,PE-C&I,PE-Electrical, | 341 | 191 |
| 493 | 0000-109-PVM-Y-001 | | | Data Sheet for Absorber | | A | A | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 214 | 64 |
| 494 | 0000-109-PVM-Y-002 | | | Data Sheet for Booster fans | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 230 | 80 |
| 495 | 0000-109-PVM-Y-003 | | | Data Sheet for Agitators for Limestone slurry Storage Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 271 | 121 |
| 496 | 0000-109-PVM-Y-004 | | | Data Sheet for Agitators for Secondary Hydroclone feed tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 271 | 121 |
| 497 | 0000-109-PVM-Y-005 | | | Data Sheet for Agitators for Auxiliary Absorbent Tank | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 271 | 121 |
| 498 | 0000-109-PVM-Y-006 | | | Data Sheet for Elevator | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 272 | 122 |
| 499 | 0000-109-PVM-Y-007 | | | Data Sheet for GGH and auxiliaries | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 237 | 87 |
| 500 | 0000-109-PVM-Y-008 | | | Data Sheet for Mist Eliminator | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 264 | 114 |
| 501 | 0000-109-PVM-Y-009 | | | Data Sheet for Spray Nozzles | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 230 | 80 |
| 502 | 0000-109-PVM-Y-011 | | | Data Sheet for Slurry Recirculation Pumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 251 | 101 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 503 | 0000-109-PVM-Y-012 | | | Data Sheet for Oxidation Air Blower | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 251 | 101 |
| 504 | 0000-109-PVM-Y-014 | | | Data Sheet for Gypsum Dewatering Pump (Bleed Pumps) | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 250 | 100 |
| 505 | 0000-109-PVM-Y-015 | | | Data Sheet for Limestone slurry pumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 250 | 100 |
| 506 | 0000-109-PVM-Y-016 | | | Data Sheet for Limestone slurry storage Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 217 | 67 |
| 507 | 0000-109-PVM-Y-017 | | | Data Sheet for Wet ball mill | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 257 | 107 |
| 508 | 0000-109-PVM-Y-018 | | | Data sheet for Insulation material | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 336 | 186 |
| 509 | 0000-109-PVM-Y-019 | | | Data sheet for Guillotine gate including sealing system | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 271 | 121 |
| 510 | 0000-109-PVM-Y-020 | | | Data sheet/Vendor catalogue for Flake glass lining | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 336 | 186 |
| 511 | 0000-109-PVM-Y-021 | | | Data sheet//Vendor catalogue for Rubber lining | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 332 | 182 |
| 512 | 0000-109-PVM-Y-022 | | | Data sheet of Agitators for Sumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical, | 271 | 121 |
| 513 | 0000-109-PVM-Y-023 | | | Data sheet of Agitators for Filtrate water tank | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 271 | 121 |
| 514 | 0000-109-PVM-Y-025 | | | Data sheet of Limestone Day SILO | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 229 | 79 |
| 515 | 0000-109-PVM-Y-026 | | | Data sheet of HOISTS/handling system | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 320 | 170 |
| 516 | 0000-109-PVM-Y-027 | | | SIZING CALCULATION & SELECTION PARAMETER FOR PRIMARY DEWATERING HYDROCYCLONE | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 250 | 100 |
| 517 | 0000-109-PVM-Y-028 | | | Data Sheet for Auxiliary Storage Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 250 | 100 |
| 518 | 0000-109-PVM-Y-029 | | | Data Sheet for Vacuum Belt filters and its auxiliries | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 278 | 128 |
| 519 | 0000-109-PVM-Y-030 | | | Data Sheet for Filtrate Water Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 252 | 102 |
| 520 | 0000-109-PVM-Y-031 | | | Data Sheet for Filtrate Water Pumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 257 | 107 |
| 521 | 0000-109-PVM-Y-032 | | | Data Sheet for Secondary Hydro-cyclone Feed Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 245 | 95 |
| 522 | 0000-109-PVM-Y-033 | | | Data Sheet for Secondary Hydro-cyclone Pump | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 264 | 114 |
| 523 | 0000-109-PVM-Y-034 | | | Data Sheet for Secondary Hydrocyclone | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 264 | 114 |
| 524 | 0000-109-PVM-Y-035 | | | Data Sheet for Waste Water Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 252 | 102 |
| 525 | 0000-109-PVM-Y-036 | | | Data Sheet for Waste Water Pump | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 264 | 114 |
| 526 | 0000-109-PVM-Y-037 | | | General Arrangement & Data Sheet of Lime Dosing System | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 229 | 79 |
| 527 | 0000-109-PVM-Y-038 | | | Data Sheet for Process Water Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 252 | 102 |
| 528 | 0000-109-PVM-Y-039 | | | Data Sheet for Water Pump | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I, | 257 | 107 |
| 529 | 0000-109-PVM-Y-042 | | | Data Sheet for Auxiliary Absorbent Pump | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 250 | 100 |
| 530 | 0000-109-PVM-Y-044 | | | Data Sheet for Sump Pumps | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 264 | 114 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 531 | 0000-109-PVM-Y-045 | | | Data Sheet for Expansion Joints | | A | B | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG, | 258 | 108 |
| 532 | 0000-109-PVM-Y-046 | | | Data Sheet for HVAC system | | A | B | FGD | MISCELLANEOUS | PE-Mech/WS | PE-Mech/SG,PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 337 | 187 |
| 533 | 0000-109-PVM-Y-047 | | | Data Sheet for Emergency Quench Tank | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Electrical,PE-C&I,PE-C&I, | 250 | 100 |
| 534 | 0000-109-PVM-Y-048 | | | Data Sheet for PIPES | | A | D | FGD | MISCELLANEOUS | PE-Mech/SG | PE-Mech/SG,PE-Mech/MH, | 250 | 100 |
| 535 | 0000-109-QVC-G-001 | | | Field Quality Plan for civil work | | A | D | FGD | MISCELLANEOUS | QA | QA | 223 | 73 |
| 536 | 0000-109-QVC-G-002 | | | Field Quality Plan for structural work | | A | D | FGD | MISCELLANEOUS | QA | QA | 233 | 83 |
| 537 | 0000-109-QVC-Q-001 | | | MQP for gratings | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 538 | 0000-109-QVC-Q-002 | | | MQP for colour coated cladddng sheet | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 539 | 0000-109-QVC-Q-003 | | | MQP for colour coated decking sheet | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 540 | 0000-109-QVC-Q-056 | | | MQP for Vibration Isolation System | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 541 | 0000-109-QVC-Q-080 | | | MQP for Structural Fabrication | | A | | FGD | | QA-Civil | QA-Civil | | |
| 542 | 0000-109-QVC-Q-082 | | | MQP for Chimney Elevator | | A | | FGD | | QA-Civil | QA-Civil | | |
| 543 | 0000-109-QVE-G-001 | | | Field Quality Plan for Electrical Work | | A | D | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 544 | 0000-109-QVE-G-002 | | | Field Quality Plan for Fire Sealing System | | A | | | | QA-Elect | QA-Elect | | |
| 545 | 0000-109-QVE-Q-001 | | | MQP for cable tray | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 546 | 0000-109-QVE-Q-002 | | | MQP for LV bus duct | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 547 | 0000-109-QVE-Q-003 | | | MQP for MCC | | A | B | FGD | MISCELLANEOUS | QA | QA | 266 | 116 |
| 548 | 0000-109-QVE-Q-004 | | | MQP for PDB, JB, LPBS, MLDB, SLDB, DCDB & ACDB | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 549 | 0000-109-QVE-Q-006 | | | MQP of Flexible Cable Tray Supporting System | | A | D | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 550 | 0000-109-QVE-Q-007 | | | MQP for Power Cables | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 551 | 0000-109-QVE-Q-008 | | | MQP for Control & Instrumentation Cables | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 552 | 0000-109-QVE-Q-009 | | | MQP for HT Motor for Booster fan | | A | B | FGD | MISCELLANEOUS | QA | QA | 286 | 136 |
| 553 | 0000-109-QVE-Q-010 | | | MQP for HT Motor for other than Booster fan (QAP FOR BALL MILL MOTOR) | | A | B | FGD | MISCELLANEOUS | QA | QA | 317 | 167 |
| 554 | 0000-109-QVE-Q-011 | | | MQP for LT Motor | | A | B | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 555 | 0000-109-QVE-Q-012 | | | MQP for Lighting Transformer | | A | B | FGD | MISCELLANEOUS | QA | QA | 336 | 186 |
| 556 | 0000-109-QVE-Q-013 | | | MQP for elevators | | A | B | FGD | MISCELLANEOUS | QA | QA | 259 | 109 |
| 557 | 0000-109-QVE-Q-014 | | | MQP for VFD | | A | B | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 558 | 0000-109-QVE-Q-015 | | | MQP for Geared Motor | | A | B | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 559 | 0000-109-QVE-Q-020 | | | MQP for HT Cables | | A | | | | QA-Elect | QA-Elect | | |
| 560 | 0000-109-QVE-Q-021 | | | MQP for Battery Charger (220/110 V) | | A | | | | QA-Elect | QA-Elect | | |
| 561 | 0000-109-QVE-Q-022 | | | MQP for HT Switchgear | | A | | | | QA-Elect | QA-Elect | | |
| 562 | 0000-109-QVE-Q-023 | | | MQP for Elect. Actuator | | A | | | | QA-Elect | QA-Elect | | |
| 563 | 0000-109-QVE-Q-024 | | | MQP for DG Set | | A | | | | QA-Elect | QA-Elect | | |
| 564 | 0000-109-QVE-Q-025 | | | MQP for Oil Filled Transformer | | A | | | | QA-Elect | QA-Elect | | |
| 565 | 0000-109-QVE-Q-051 | | | MQP for Suspended Magnets | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 566 | 0000-109-QVE-Q-052 | | | MQP for Belt Weigher | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 567 | 0000-109-QVE-Q-053 | | | MQP for Metal Detector | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 568 | 0000-109-QVE-Q-054 | | | MQP for Magnetic Separator | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 569 | 0000-109-QVE-Q-055 | | | MQP of HT Motor (Imported) | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 570 | 0000-109-QVE-Q-056 | | | MQP of LT Motor FOR AIR COMPRESSOR (ABB MAKE) | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 571 | 0000-109-QVE-Q-057 | | | MQP FOR BOOSTER FAN CABLES | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 572 | 0000-109-QVI-G-001 | | | FQP for Instrumentation work | | A | D | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 573 | 0000-109-QVI-Q-001 | | | MQP for SO2 analyzer | | A | B | FGD | MISCELLANEOUS | QA | QA | 292 | 142 |
| 574 | 0000-109-QVI-Q-002 | | | MQP for pressure switch / DP switch | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 575 | 0000-109-QVI-Q-003 | | | MQP for RTD with thermowell | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 576 | 0000-109-QVI-Q-004 | | | MQP for Temperature Transmitter / DP Transmitter / Pressure Transmitter | | A | B | FGD | MISCELLANEOUS | QA | QA | 293 | 143 |
| 577 | 0000-109-QVI-Q-005 | | | MQP for flow transmitter | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 578 | 0000-109-QVI-Q-006 | | | MQP for PLC | | A | B | FGD | MISCELLANEOUS | QA | QA | 264 | 114 |
| 579 | 0000-109-QVI-Q-007 | | | MQP for Flow switch | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 580 | 0000-109-QVI-Q-008 | | | MQP for temperature switch | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 581 | 0000-109-QVI-Q-009 | | | MQP for Vibration transmitter with sensor | | A | B | FGD | MISCELLANEOUS | QA | QA | 293 | 143 |
| 582 | 0000-109-QVI-Q-010 | | | MQP for UPS | | A | B | FGD | MISCELLANEOUS | QA | QA | 319 | 169 |
| 583 | 0000-109-QVI-Q-011 | | | MQP for battery charger | | A | B | FGD | MISCELLANEOUS | QA | QA | 508 | 358 |
| 584 | 0000-109-QVI-Q-012 | | | MQP for Instrument Cable | | A | B | FGD | MISCELLANEOUS | QA | QA | 315 | 165 |
| 585 | 0000-109-QVI-Q-013 | | | MQP for GGH Control (GGH Soot Blower) | | A | B | FGD | MISCELLANEOUS | QA | QA | 250 | 100 |
| 586 | 0000-109-QVI-Q-014 | | | MQP for Ni-Cd Battery | | A | B | FGD | MISCELLANEOUS | QA | QA | 511 | 361 |
| 587 | 0000-109-QVI-Q-015 | | | MQP for LIE/LIR | | A | B | FGD | MISCELLANEOUS | QA | QA | 511 | 361 |
| 588 | 0000-109-QVI-Q-016 | | | MQP for Control Valve | | | | | | QA-C&I | QA-C&I | | |
| 589 | 0000-109-QVI-Q-017 | | | MQP for Thermocouple with thermowell | | | | | | QA-C&I | QA-C&I | | |
| 590 | 0000-109-QVI-Q-018 | | | MQP for Impulse Pipe & Tube | | | | | | QA-C&I | QA-C&I | | |
| 591 | 0000-109-QVI-Q-019 | | | MQP for Instrument valve | | | | | | QA-C&I | QA-C&I | | |
| 592 | 0000-109-QVI-Q-020 | | | MQP for Fiber Optics Cable | | | | | | QA-C&I | QA-C&I | | |
| 593 | 0000-109-QVI-Q-021 | | | MQP for Transducer | | | | | | QA-C&I | QA-C&I | | |
| 594 | 0000-109-QVI-Q-022 | | | MQP for control desk | | | | | | QA-C&I | QA-C&I | | |
| 595 | 0000-109-QVI-Q-023 | | | MQP for Flue Gas analyser panel | | | | | | QA-C&I | QA-C&I | | |
| 596 | 0000-109-QVI-Q-024 | | | MQP for RF type Level Switch | | | | | | QA-C&I | QA-C&I | | |
| 597 | 0000-109-QVI-Q-025 | | | MQP for CEMS | | | | | | QA-C&I | QA-C&I | | |
| 598 | 0000-109-QVI-Q-026 | | | MQP for Fire Alarm system | | | | | | QA-C&I | QA-C&I | | |
| 599 | 0000-109-QVI-Q-027 | | | MQP for Local control panel( Blank encloser) for fire alarm panel | | | | | | QA-C&I | QA-C&I | | |
| 600 | 0000-109-QVI-Q-072 | | | MQP for Actuators(without IS) | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 601 | 0000-109-QVI-Q-073 | | | MQP for Actuators(with IS) | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 602 | 0000-109-QVI-Q-075 | | | MQP for PDB of M/s pyrotech Electronics Udaipur | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 603 | 0000-109-QVM-G-001 | | | FQP for Material Receipt & Stoarge (Storage & preservation Manual at site) | | A | D | FGD | MISCELLANEOUS | QA | QA | 270 | 120 |
| 604 | 0000-109-QVM-G-002 | | | Field Quality Plan for Mechanical work Part 1 - FQP for Absorber, Tanks, Silo, Ducts, pipe lines etc including Welding Manual, Heat Treatment Manuals | | A | D | FGD | MISCELLANEOUS | QA | QA | 233 | 83 |
| 605 | 0000-109-QVM-G-003 | | | Field Quality Plan for Mechanical work Part 2 - Field Quality Plan of different Mechanical Equipment for Wet FGD plant | | A | D | FGD | MISCELLANEOUS | QA | QA | 233 | 83 |
| 606 | 0000-109-QVM-G-004 | | | Field Quality Plan for Mechanical work Part 3 - Field Quality Plan of DUCTS | | A | D | FGD | MISCELLANEOUS | QA | QA | 233 | 83 |
| 607 | 0000-109-QVM-G-005 | | | FQP RECEIPT AND STORAGE- Limestone & Gypsum Handling Plant | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 608 | 0000-109-QVM-G-006 | | | FQP FOR MECHANICAL ERECTION-Limestone & Gypsum Handling Plant | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 609 | 0000-109-QVM-G-077 | | | Field Quality Plan for Elevator | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 610 | 0000-109-QVM-Q-002 | | | MQP for FGD SUPPORT STRUCTURE (COLUMNS BEAMS & BRACING) | | A | D | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 611 | 0000-109-QVM-Q-004 | | | MQP for Non Metallic Expansion Joint | | A | B | FGD | MISCELLANEOUS | QA | QA | 261 | 111 |
| 612 | 0000-109-QVM-Q-005 | | | MQP for Agitator | | A | B | FGD | MISCELLANEOUS | QA | QA | 258 | 108 |
| 613 | 0000-109-QVM-Q-006 | | | MQP for Oxidation Blower | | A | B | FGD | MISCELLANEOUS | QA | QA | 238 | 88 |
| 614 | 0000-109-QVM-Q-007 | | | MQP for Horizontal Vacuum Belt Filter with Pump and accessories | | A | B | FGD | MISCELLANEOUS | QA | QA | 223 | 73 |
| 615 | 0000-109-QVM-Q-008 | | | MQP for pipes & tubes | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 616 | 0000-109-QVM-Q-009 | | | MQP for recirculation slurry pump | | A | B | FGD | MISCELLANEOUS | QA | QA | 224 | 74 |
| 617 | 0000-109-QVM-Q-010 | | | MQP for slury pump | | A | B | FGD | MISCELLANEOUS | QA | QA | 240 | 90 |
| 618 | 0000-109-QVM-Q-011 | | | MQP for clear water pump | | A | B | FGD | MISCELLANEOUS | QA | QA | 244 | 94 |
| 619 | 0000-109-QVM-Q-012 | | | MQP for Dampers & Seal air fan with heater & Gates | | A | B | FGD | MISCELLANEOUS | QA | QA | 272 | 122 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 620 | 0000-109-QVM-Q-013 | | | MQP for GGH with accessories | | A | B | FGD | MISCELLANEOUS | QA | QA | 210 | 60 |
| 621 | 0000-109-QVM-Q-014 | | | MQP for Lime Stone & Gypsum Handling System | | A | B | FGD | MISCELLANEOUS | QA | QA | 257 | 107 |
| 622 | 0000-109-QVM-Q-015 | | | MQP for Hoist | | A | B | FGD | MISCELLANEOUS | QA | QA | 320 | 170 |
| 623 | 0000-109-QVM-Q-016 | | | MQP for Air Receiver | | A | D | FGD | MISCELLANEOUS | QA | QA | 314 | 164 |
| 624 | 0000-109-QVM-Q-017 | | | MQP for insulation | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 625 | 0000-109-QVM-Q-018 | | | MQP for REAGENT PREPARATION SYSTEM (Ball mill with accessories) | | A | B | FGD | MISCELLANEOUS | QA | QA | 244 | 94 |
| 626 | 0000-109-QVM-Q-019 | | | MQP for Booster Fan wirg accessories | | A | B | FGD | MISCELLANEOUS | QA | QA | 286 | 136 |
| 627 | 0000-109-QVM-Q-020 | | | MQP for foundation bolts | | A | D | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 628 | 0000-109-QVM-Q-020A | | | MQP for foundation bolts M/s Quality Engineering Works, Kolkata | | A | D | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 629 | 0000-109-QVM-Q-020B | | | MQP for foundation bolts M/s Indiana Conveyors, Jejuri | | A | D | FGD | MISCELLANEOUS | QA | QA | 322 | 172 |
| 630 | 0000-109-QVM-Q-021 | | | MQP for Instrument Air Compressor | | A | B | FGD | MISCELLANEOUS | QA | QA | 243 | 93 |
| 631 | 0000-109-QVM-Q-022 | | | MQP for Air Dryer | | A | B | FGD | MISCELLANEOUS | QA | QA | 311 | 161 |
| 632 | 0000-109-QVM-Q-023 | | | MQP for FGD valves | | A | B | FGD | MISCELLANEOUS | QA | QA | 314 | 164 |
| 633 | 0000-109-QVM-Q-024 | | | MQP for air conditiong and ventilation system | | A | B | FGD | MISCELLANEOUS | QA | QA | 337 | 187 |
| 634 | 0000-109-QVM-Q-031 | | | MQP for Absorber Tank | | A | | | | QA | QA | | |
| 635 | 0000-109-QVM-Q-032 | | | MQP for Hydro Cyclone | | A | | | | QA | QA | | |
| 636 | 0000-109-QVM-Q-055 | | | MQP for Crusher | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 637 | 0000-109-QVM-Q-057 | | | MQP for Sampling System | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 638 | 0000-109-QVM-Q-058 | | | MQP for Dust Extraction System | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 639 | 0000-109-QVM-Q-059 | | | MQP for Dust Suppression System | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 640 | 0000-109-QVM-Q-060 | | | MQP for Elevator(rack and Pinion Type) | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 641 | 0000-109-QVM-Q-061 | | | MQP for Sump Pump | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 642 | 0000-109-QVM-Q-062 | | | MQP for Ventilation System | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 643 | 0000-109-QVM-Q-063 | | | MQP for Fabric Belts | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 644 | 0000-109-QVM-Q-064 | | | MQP for Belt Vulcanizer | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 645 | 0000-109-QVM-Q-065 | | | MQP for Idler | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 646 | 0000-109-QVM-Q-066 | | | MQP for Pulley | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 647 | 0000-109-QVM-Q-067 | | | MQP for Helical or Bevel Gear Boxes | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 648 | 0000-109-QVM-Q-068 | | | MQP for Vibration monitoring System | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 649 | 0000-109-QVM-Q-069 | | | MQP for Fluid Coupling(traction type) | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 650 | 0000-109-QVM-Q-070 | | | MQP for CI Gate/globe/Check Valves(Upto 600 NB PN-1.6) | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 651 | 0000-109-QVM-Q-071 | | | MQP for Flap Gate Gate | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 652 | 0000-109-QVM-Q-073 | | | MQP for Support Structure | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 653 | 0000-109-QVM-Q-074 | | | MQP for Bucket Elevator | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 654 | 0000-109-QVM-Q-075 | | | MQP for Rotary Feeder | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 655 | 0000-109-QVM-Q-076 | | | MQP for Travelling Tripper | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 656 | 0000-109-QVM-Q-078 | | | MQP for slury pump (Imported) | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 657 | 0000-109-QVM-Q-079 | | | MQP for Slurry Pump (Sump Type) ¿ Supplier is Sam Turbo, Coimabtur, India | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 658 | 0000-109-QVM-Q-080 | | | MQP for Structural Fabrication | | A | - | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 659 | 0000-109-QVM-Q-081 | | | MQP for Hoists up to 15 MT | | A | - | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 660 | 0000-109-QVM-Q-086 | | | MQP for Technological Structure | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 661 | 0000-109-QVM-Q-087 | | | MQP for Silo | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 662 | 0000-109-QVM-Q-088 | | | MQP for Pipe Expansion Joint | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 663 | 0000-109-QVM-Q-089 | | | MQP for Geared Motor for Bucket Elevator | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 664 | 0000-109-QVM-Q-090 | | | MQP for Valve (Ball, Gate, Globe, Check Valve) | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 665 | 0000-109-QVM-Q-091 | | | MQP for Knife Gate Valve | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 666 | 0000-109-QVM-Q-092 | | | MQP for Diaphragm Valve (Main Package) | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |

| S. No. | NTPC_DRG_NO | Rev_drg_no_for_inouhse_drg | TO_BE_SHIFTED_TO_PACKAGE | DRG_TITLE | PROJECT_SPECIFC_INFORMATION | DRG_PURPOSE | DRG_TYPE | AREA | MILESTONE | CUSTODIAN | REVIEWERS | SUB_FROM_MP_AWARD | SUB_FROM_FGD_AWARD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 667 | 0000-109-QVM-Q-093 | | | MQP for Axial Flow Fan with motor for Ventilation System | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 668 | 0000-109-QVM-Q-094 | | | MQP for Ventilation Fan | | A | B | FGD | MISCELLANEOUS | QA | QA | 350 | 200 |
| 669 | 0000-109-QVM-Q-095 | | | MQP for Butterfly Valve 1200 mm dia | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 670 | 0000-109-QVM-Q-096 | | | MQP for Expansion Joints A/c Booster Fan | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 671 | 0000-109-QVM-Q-097 | | | MQP for Ball Valve (M/s Leader) | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 672 | 0000-109-QVM-Q-098 | | | MQP of Centrifugal Fan of Dust Extraction System | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 673 | 0000-109-QVM-Q-099 | | | MQP for Rubber Lined Pipe | | A | B | FGD | MISCELLANEOUS | QA | QA | 171 | 21 |
| 674 | 0000-109-QVM-Q-101 | | | Apron feeder | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 675 | 0000-109-QVM-Q-102 | | | Paddle feeder | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 676 | 0000-109-QVM-Q-103 | | | Vibrating Screen feeder | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 677 | 0000-109-QVM-Q-104 | | | Vibrating feeder | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 678 | 0000-109-QVM-Q-105 | | | MQP for Fluid Coupling(Scoop Type) | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 679 | 0000-109-QVM-Q-106 | | | MQP for Rack & Pinion Gate | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 680 | 0000-109-QVM-Q-107 | | | Centrifugal pump | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 681 | 0000-109-QVM-Q-108 | | | Strainer | | A | B | FGD | MISCELLANEOUS | QA | QA | | |
| 682 | 0000-109-QVM-Q-120 | | | MQP OF CONDENSING UNIT | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 683 | 0000-109-QVM-Q-121 | | | MQP OF AHU | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 684 | 0000-109-QVM-Q-122 | | | MQP OF CENDRIFUGAL FAN | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 685 | 0000-109-QVM-Q-123 | | | MQP OF PAC | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 686 | 0000-109-QVM-Q-124 | | | MQP OF UAF | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 687 | 0000-109-QVM-Q-125 | | | MQP OF HORIZONTAL CENTRIFUGAL PUMP | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 688 | 0000-109-QVM-Q-126 | | | MAP OF PIPE | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 689 | 0000-109-QVM-Q-127 | | | MQP OF VALVES ( GATE, BLOBE & CHECK) | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 690 | 0000-109-QVM-Q-128 | | | MQP OF BUTTERFLY VALVE | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 691 | 0000-109-QVM-Q-129 | | | MQP OF FILTERS | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 692 | 0000-109-QVM-Q-130 | | | MQP OF THERMAL INSULATION GLASS WOOL/ ROCK WOOL | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 693 | 0000-109-QVM-Q-131 | | | MQP OF THERMAL INSULATION NITRIL RUBBER/ POLEURETHANE FOAM/ POLYISOCYNURATE FOAM | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 694 | 0000-109-QVM-Q-133 | | | MQP OF PHE | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 695 | 0000-109-QVM-Q-134 | | | MQP OF PIPE | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 696 | 0000-109-QVM-Q-135 | | | MQP OF VALVES | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 697 | 0000-109-QVM-Q-136 | | | MQP OF HORIZONTAL CENTRIFUGAL PUMP | | | | FGD | | QA Mech BOP | QA Mech BOP | | |
| 698 | 0000-109-QVM-W-001 | | | QA programme | | I | D | FGD | MISCELLANEOUS | QA | QA | 210 | 60 |
| 699 | 0000-109-QVM-W-002 | | | QA Organisation for implementation and QA system manual | | I | D | FGD | MISCELLANEOUS | QA | QA | 180 | 30 |
| 700 | 0000-109-QVM-W-005 | | | WPS for Carbon Steel Welding at site | | A | D | FGD | MISCELLANEOUS | QA | QA | 248 | 98 |
| 701 | 0000-109-QVM-W-006 | | | WPS for SS welding at site | | A | D | FGD | MISCELLANEOUS | QA | QA | 248 | 98 |
| 702 | 0000-109-QVM-W-008 | | | WPS (E-7018 & FCAW) for WFGD Steel Structural Work | | A | D | FGD | MISCELLANEOUS | QA | QA | 248 | 98 |
| 703 | 0000-109-QVM-W-009 | | | WPS for CS to SS Welding | | A | D | FGD | MISCELLANEOUS | QA | QA | 248 | 98 |
| 704 | 0000-109-QVM-W-010 | | | WPS for Welding at Shop (CS & SS) | | A | D | FGD | MISCELLANEOUS | QA | QA | 248 | 98 |
| 705 | 0000-109-QVM-W-011 | | | QA Documentation Package for items / equipmentmanufactured and despatched to site | | I | D | FGD | MISCELLANEOUS | QA | QA | 341 | 191 |
| 706 | 0000-109-QVM-W-012 | | | QA Documentation Package for field activities on equip-ment/systems at site | | I | D | FGD | MISCELLANEOUS | QA | QA | 341 | 191 |
| 707 | 0000-109-QVM-W-013 | | | WPS for SAW Welding (Indiana, Jejuri) | | A | D | FGD | MISCELLANEOUS | QA | QA | 248 | 98 |
| 708 | 0000-109-QVM-W-014 | | | WPS for Shop Welding (Crusher) | | A | D | FGD | MISCELLANEOUS | QA | QA | 248 | 98 |
| 709 | 0000-109-QVM-W-020 | | | WPS for Limestone & Gypsum Handling System | | A | D | FGD | MISCELLANEOUS | QA | QA | 248 | 98 |
| 710 | 0000-109-QVM-W-30 | | | WPS for AC & Ventilation System of FGD | | | | FGD | | QA Mech BOP | QA Mech BOP | | |

# NTPC Limited

(A Government of India Enterprise)

# LOT 1A PROJECTS

# PART – B
# (DETAILED TECHNICAL SPECIFICATION)

# SUB-SECTION-III-C
# (CONTROL & INSTRUMENTATION SYSTEM)

# SECTON – VI

# TECHNICAL SPECIFICATION

# FOR

# FLUE GAS DESULPHURISATION (FGD)

# SYSTEM PACKAGE

**BIDDING DOCUMENT NO. : CS-0011-109(1A)-2**

# PART – B (DETAILED TECHNICAL SPECIFICATION)

# SUB-SECTION-III-C (CONTROL & INSTRUMENTATION SYSTEM)

# SUB-SECTION-III-C1

# BASIC DESIGN CRITERIA

## BASIC DESIGN CRITERIA

**1.00.00 GENERAL REQUIREMENTS**

1.01.00 The Contractor shall provide Independent Control & Instrumentation system for control, monitoring and operation of associated drives in all regimes of operation in safe and most efficient manner including Primary and Secondary Instruments, Panels/ Desks, Process Connection and Piping, charges & batteries, associated Instrumentation Cables etc. as identified in the specification.

1.02.00 The Contractor shall provide all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipments ensuring operability, maintainability and reliability. This work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guides, statutory regulations and safety requirements in force.

1.03.00 Further Bidder shall also include in his proposal and shall furnish all equipment, devices and services which may not be specifically stated in the specification but are needed for completeness of the equipment/systems furnished by the Bidder and for meeting the intent and requirements of the specification.

1.04.00 Bidder shall include in his bid a detailed Bill of Material (BOM) for each of the systems.

1.05.00 In addition to requirements specified under this Section-VI, Part-B, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.

**2.00.00 RELIABILITY AND AVAILABILITY**

2.01.00 Each component and system offered by the Bidder shall be of established reliability. The minimum target reliability of each piece of equipment like each electronic module/card, Power supply, Peripheral etc. shall be established by the Bidder, considering its failure rate/mean time between failures (MTBF), meantime to repair (MTTR), such that the availability of the complete C&I system is assured .

2.02.00 When more than one device uses the same measurement or control signal, the transmitter and other components/ module shall be fully equipped to provide all signal requirements. All the 4-20 mA output signals from transmitters/other control system shall be able to drive minimum 500 Ohms load resistance. The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.

| | |
|---|---|
| 2.03.00 | To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level to satisfy the availability criteria mentioned above. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment. |
| **3.00.00** | **OPERABILITY & MAINTAINABILITY** |
| 3.01.00 | The design of the control systems and related equipments shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved. 'Fail Safe' operation signifies that the loss of signal, loss of excitation or failure of any component shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimised . |
| 3.02.00 | The types of failure that shall be taken into account for ensuring operability of the plant shall include but not be limited to:<br>— Failure of sensor or transmitter.<br>— Failure of main and/or redundant controller/other modules.<br>— Loss of motive power to final control element.<br>— Loss of control power.<br>— Loss of instrument air. |
| 3.03.00 | The choice of hardware shall also take into account sound maintainability principles and techniques. The same shall include but shall not be limited to the following:<br>— Standardization of parts.<br>— Minimum use of special tools.<br>— Grouping of functions.<br>— Interchangeability.<br>— Malfunction identification facility/self surveillance facility.<br>— Easy modular replacement.<br>— Fool proof design providing proper identification and other features to preclude improper mounting and installation.<br>— Appropriate de-rating of electronic components and parts. |

3.04.00 The equipment shall employ latest state of the art technology to guard against obsolescence. In any case, Bidder shall be required to ensure supply of spare parts for lifetime of the plant. In case, the Bidder feels that certain equipment/component is likely to become obsolete, the Bidder shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence.

3.05.00 Control & Monitoring

3.05.01 The control, monitoring & operation of flue gas desulphurization system shall be as detailed out in Sub-section PLC Based Control system and Sub-section C & I for flue gas desulphurization system. Further, flue gas desulphurization system, link shall be provided for collection of data in the DDCMIS (In Employer's Scope) in UCR for the information of unit-incharge / shift-incharge etc. through Station Wide LAN.

**4.00.00 ENVIRONMENTAL CONDITIONS**

4.01.00 Instruments, devices and equipments for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired utility station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.

| Ambient Temperature (outside cabinets) | Pressure | Relative humidity | Atmosphere | Required protection Class of panels/ cabinets/ desks to be provided by contractor. |
|---|---|---|---|---|
| **Outdoor Location** | | | | |
| 55 degree C max. | Atmosp here | 100 % Max. | Air (dirty) | IP 55 |
| 4 degree C min. | Atmosp here | 5 % min. | Air (dirty) | IP 55 |
| **Indoor Location** | | | | |
| 55 degree C max. | Atmosp here | 95 % Max. | Air | IP 54** |

| | | | | |
|---|---|---|---|---|
| 4 degree C min. | Atmosphere | 5 % min. | Air | IP 54** |
| **Air Conditioned Areas** | | | | |
| 24 +/- 5 degree C normal | Atmosphere | 95 % Max. | Air | IP 22*** |
| 50 degree C max. * | Atmosphere | 5 %min. | Air | IP 22*** |
| * During air conditioning failure. | | | | |
| ** For non-ventilated enclosures. For ventilated enclosures, protection class shall be IP 42. | | | | |
| *** With a suitable canopy at the top to prevent ingress of dripping water. | | | | |

For PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 Deg.C. For mini-UPS, the same shall be 40 Deg.C.

**5.00.00 GROUNDING SYSTEM**

All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels.

The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).

Shield on instrumentation cables shall be grounded on panel side. When shielding termination are required in cabinets furnished under this specification, suitable terminals shall be furnished on copper flat forming system ground. System and shield ground shall be connected to earthing strip using suitable size of cable to be provided by the contractor.

The Contractor shall submit with the offer recommended grounding scheme required for his system. The exact grounding scheme shall be finalised during detailed engineering.

# SUB-SECTION-III-C2

# MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 1.00.00 | **MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)** |
| 1.01.00 | Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval. |
| 1.02.00 | Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus. |
| 1.03.00 | All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering. |
| 1.04.00 | The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm. |
| 1.05.00 | All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor).<br>For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications.<br>For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum. |
| 1.06.00 | For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments. |
| 1.07.00 | The instruments, for which technical specification is not attached, shall be supplied as per the standard and proven practice of the contractor. The same shall be established by the contractor during detailed engineering by providing detailed explanation/concepts, if required by the employer, of such implementation along with standard documentation. |

2.00.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

2.01.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS**

| Sl.No. | Features | Essential/Minimum Requirements |
|---|---|---|
| 1. | Type of Transmitter | Microprocessor based 2 wire type (loop powered), Hart protocol compatible. |
| 2. | Accuracy | ± 0.1% of calibrated span (minimum) |
| 3. | Output signal range | 4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol) |
| 4. | Turn down ratio (minimum) | 10:1 for vacuum/very low pressure applications (i.e. pressure <= 200 mmWC)<br>5:1 for very high pressure application (i.e. pressure >= 200 Kg/cm2)<br>30:1 for other applications |
| 5. | Stability | ± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm² <br>± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² |
| 6. | Zero and span drift | +/- 0.015% per deg.C at max span<br>+/-0.11% per deg.C at min. Span |
| 7. | Load impedance | 500 ohm (minimum) |
| 8. | Housing | Weather proof as per IP-65, metallic housing with durable corrosion resistant coating |
| 9. | Over Pressure | 150% of max. Operating pressure |
| 10. | Connection (Electrical) | Plug and socket type |
| 11. | Process connection | 1/2 inch NPT (F) |
| 12. | Span and Zero | Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility. |
| 13. | Accessories | -Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.<br>-2 valve manifold for absolute & Gauge pressure transmitters, 3-valve and 5 valve manifold for DP/Level/Flow applications. The valve manifold shall be non integral type (except Fuel Oil area). |

| | | |
|---|---|---|
| | | -For hazardous area, explosions proof enclosure as described in NEC article 500<br>Mounting: 2 inch pipe mounting. |
| 14. | Diagnostics & display | Self-Indicating feature and digital display on transmitter |
| 15. | Power supply | 24V DC ± 10%. |
| 16. | Adjustment/calibration/maintenance | From hand held HART calibrator/ centralized PC based system (as applicable). |

Notes

- For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement.
- LVDT type is not acceptable.
- Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2.02.00 **GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER**

| | |
|---|---|
| Type | Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter. |
| Principle | TDR (Time domain reflectometry) |
| Probe Type & Material | (i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention.<br><br>(ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable. |
| Output signal | 4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention. |
| Accuracy | +/- 0.5% of calibrated span or minimum 5mm. |
| Power supply | 24 VDC +/- 10%. |
| Housing | Weather proof as per IP-65, metallic housing with durable corrosion resistance coating. |

| | |
|---|---|
| Adjustment/ calibration | Using hand held HART calibrator/ centralized PC based system (as applicable). |
| Zero & span adjustment | Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc. |
| Display | Integral digital display. |
| Load Impedance | 500 ohms (minimum). |
| Electromagnetic compatibility | Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2 |
| Mounting | (i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor.<br><br>(ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor.<br><br>(iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. |

Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

2.03.00 **Ultrasonic Type level Transmitter**

| S.No. | Features | Essential/Minimum requirement |
|---|---|---|
| 1. | Type of Transmitter | Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter. |
| 2. | Output signal | 4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol). |

| | | |
|---|---|---|
| 3. | Accuracy | +/- 0.5% of calibrated span or minimum 5mm. |
| 4. | Power supply | 24 V DC +/- 10%. |
| 5. | Temperature compensation | To be provided within transducer. |
| 6. | Housing | Weather proof as per IP-65, metallic housing with durable corrosion resistance coating. |
| 7. | Adjustment/calibration/ maintenance | Using hand held HART calibrator/ centralized PC based system (as applicable). . |
| 8. | Zero and Span adjustment | Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc. |
| 9. | Sensor Material | Corrosion resistant material to suit individual application requirement. |
| 10. | False signal tolerance | Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry. |
| 11. | Range | Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc. |
| 12. | Display | Integral digital display |
| 13. | Diagnostics | Loss of echo alarm etc. |
| 14. | Load Impedance | 500 ohms (minimum). |
| 15. | Electrical Connection | Plug and socket |

| | | |
|---|---|---|
| 16. | Accessories | • All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.<br>• All mounting accessories required for erection and commissioning shall be provided.<br>• For hazardous area, explosion proof enclosure as described in NEC article 500 |

**Note:**

1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under "ultrasonic transmitters" category for fly ash silo level.

2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.

2.04.00 **Specification for ULTRASONIC TYPE FLOW TRANSMITTER**

| S.No | Features | Essential/Minimum requirement |
|---|---|---|
| 1. | Type of Transmitter | Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Insertion type. |
| **2.** | Output signal | 4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol). |
| **3.** | Sensor Accuracy | +/- 2% of calibrated span. |

| | | |
|---|---|---|
| **4.** | Power supply | 24 V DC +/-10%. |
| **5.** | Temperature compensation | To be provided within transducer. |
| **6.** | Housing | Weather proof as per IP-55 with durable corrosion resistance coating. |
| **7.** | Adjustment/calibration/ maintenance | From hand held calibrators/centralized PC based system (as applicable). |
| **8.** | Zero and Span adjustment | Continuous, tamper proof, remote as well as manual to calibrate the instrument without any process flow. |
| **9.** | Sensor Material | Corrosion resistant material to suit individual application requirement. |
| **10.** | False signal tolerance | Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry. |
| **11.** | Range | Should be suitable for the required process range. |
| **12.** | Display | LCD display with integral keypad to be provided. |
| **13.** | Diagnostics | Loss of echo alarm etc. |
| **14.** | Load Impedance | 500 ohms minimum |
| **15.** | Electrical Connection | Plug and socket |
| **16.** | Accessories | • All weather canopy for protection from direct sunlight and direct rain.<br>• All mounting hardware and accessories required for erection and commissioning mounting fittings materials shall be SS 316.<br>• For hazardous area, explosion proof enclosure as described in NEC article 500 |

2.05.00 **HART Hand Held calibrator**

Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.

3.00.00 **Temperature Elements and accessories**

3.01.00 **Thermocouple**

| Sr. No. | Features | | Essential/Minimum Requirements |
|---|---|---|---|
| 1 | Type of Thermocouple. | : | 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type). |
| 2 | No. of element | : | Duplex |
| 3 | Housing/Head | : | IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well. |
| 4 | Insulation and Sheathing of Thermocouple | : | Swaged type mineral (magnesium oxide) insulation and SS316 sheath. |
| 5 | Calibration and accuracy | : | As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C. |
| 6 | Accessories | : | Thermo well and associated fittings |
| 7 | Standard | : | IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well |

3.02.00 **Resistance Temperature Detector ( RTD )**

| Sr. No. | Features | | Essential/Minimum Requirements |
|---|---|---|---|
| 1 | Type of RTD. | : | Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade). |
| 2 | No. of element | : | Duplex |
| 3 | Housing/Head | : | IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well |
| 4 | Insulation and sheathing of RTD | : | Mineral (magnesium oxide) insulation and SS316 sheath, |
| 5 | Calibration and accuracy | : | As per As per IEC-751/ DIN-43760 Class-A for RTD |
| 6 | Accessories | : | Thermo well and associated fittings |
| 7 | Standard | : | IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well. |

**NOTES :**

1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.

2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

3.03.00 **Metal Temperature Thermocouples**

| | |
|---|---|
| Measuring Medium | Metal Temperature |
| Material of Thermocouple. | Chromel Alumel Type K |
| Type of Thermocouple | Duplex with ungrounded separate hot junctions |
| Insulation | Mineral Insulation (Magnesium Oxide). |

| | |
|---|---|
| Thermocouple wire gauge | 16 AWG |
| Protective sheath | SS 321 |
| Protective sheath dia | 8 mm OD |
| Calibration & accuracy | As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C |
| Mounting accessories | 1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard. |
| Cold end sealing | SS pot seal with colour coded PTFE Insulated flexible tails. Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm. |
| Minimum bending radius | 30 mm |
| Length of T/C | On as required basis considering location of measurement point and the JB/TTJB location. |

**Notes :**

1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.

3.04.00 **Thermo well** (for all process temp. elements)

(a) Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974)

(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.

(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).

(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.

3.05.00 TEMPERATURE TRANSMITTER (TT)

Following types of 2-wire (loop powered) temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. Temperature transmitter and associated temperature element shall be factory fitted.

b. Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JBs. The specifications of the JBs shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

c. Dual-input Temperature Transmitter With **integral** Indicator:

These shall be suitable for mounting on pipes/ support. Both elements of the duplex thermocouple/ RTD shall be wired to a single transmitter. Integral indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum.

d. Common requirements for each of the above type of temperature transmitters.

| | | | |
|---|---|---|---|
| Output | : | 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. | |
| Input | : | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K & R types (input type to be selectable at site through HART terminal). | |
| Isolation | : | Min. 500 V AC. | |
| EMC compatibility | : | As per EN 61326. | |
| Operating ambient temperature | : | 0 to 85 deg C (without indicator). | |
| | | 0 to 70 deg C (with indicator). | |
| Power supply | | 24V DC +/- 10%. | |
| Accessories | | Mounting arrangements including clamps etc. | |
| Composite Accuracy | (i) | For head mounted and DIN-rail mounted types: | |
| (Refer note 2 ) | | RTD | =<0.4% of 0-250 deg C span |
| | | T/C-K type | =<0.4% of 0-600 deg C span |
| | | T/C-R type | =<0.4% of 0-1000 deg C span |
| | | CJC accuracy (for thermocouples) shall be =< 1 deg C | |
| | (ii) | For dual-input type: | |
| | | RTD | =<0.25% of 0-250 deg C span |
| | | T/C-K type | =<0.2% of 0-600 deg C span |
| | | CJC accuracy (for thermocouples) shall be =< 1 deg C | |

Notes ***(Common for a) to d) above):-***

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters are to be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input specified in (i) & (ii).

4.00.00 **SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.**

| Sl. No | FEATURES | ESSENTIAL/MINIMUM REQUIREMENTS | | |
|---|---|---|---|---|
| | | Pr. Gauge/ DP Gauge/ Draught gauges | Temperature Gauge | Level Gauge |
| 1 | Sensing Element | Bourdon for high pressure, Diaphragm/ Bellow for low pr. | Inert gas actuated/ Liquid filled other than mercury | Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type. |
| 2 | Material of sensing element | SS 316 | SS 316 | |
| 3 | Material of movement | SS 304 | SS 304 | |
| 4 | Body material | Die-cast aluminium | Die-cast aluminium | Forged carbon steel/304 SS |
| 5 | Dial size | 150mm | 150 mm | Tubular covering entire range |
| 6 | End connection | 1/2 inch NPT (M) | 1/2 inch or 3/4 inch NPT (M). | Process connection as per ASME PTC and drain/vent 15 NB |

| | | | | |
|---|---|---|---|---|
| 7 | Accuracy | ±1% of span | ± 1% of span | ± 2% |
| 8 | Scale | Linear, 270° arc graduated in metric units | Linear, 270° arc graduated in °C | Linear vertical |
| 9 | Range selection | Shall cover 125% of max. operating press | Shall cover 125% of max. operating temp | Shall cover max. Operating level. |
| 10 | Over range | 125% of FSD | 125% of FSD | - |
| 11 | Housing | Weather and dust proof as per IP-55 | Weather and dust proof as per IP-55 | CS/304 SS leak proof |
| 12 | Zero/span adjustment | Provided | Provided | -- |
| 13 | Identification | Engraved with service legend or laminated phenolic name plate | | |
| 14 | Accessories | Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve | SS Thermowell | Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement. |
| Notes:- | | | | |

*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

5.00.00 **PROCESS ACTUATED SWITCHES**

| FEATURES | ESSENTIAL / MINIMUM REQUIREMENTS | | |
|---|---|---|---|
| | Pressure/ Draft Switches/ DP Switches | Temperature switches | Level switches |
| Sensing Element | Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum | Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application) | Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. . |
| Material | 316 SS | Bulb 316 SS/ capillary 304 SS | 316 SS |
| End connection | ½ inch NPT (F) | ½ inch NPT (F) | Manufacturer standard |
| Over range/ proof pressure | 150% of maximum operating pr. | - | 150% of maximum operating pr. |
| Repeatability | +/- 0.5% of full range | | |
| No. of contacts | 2 No.+2NC. SPDT snap action dry contact | | |
| Rating of contacts | 60 V DC, 6 VA (or more if required by DDCMIS) | | |
| Elect. Connection | Plug in socket. | | |
| Set point adjustment | Provided over full range. | | |
| Dead band adjustment | Adjustable/ fixed as per requirement of application. | | |
| Enclosure | Weather and dust proof as per IP-55, metallic housing. | | |
| Accessories | Siphon, snubber, chemical seal, pulsation dampeners as required by process | Thermo well of 316 SS and packing glands | All mounting accessories |
| Mounting | Suitable for enclosure/ rack mounting or direct mounting | Suitable for rack mounting or direct mounting | - |

| | |
|---|---|
| Power Supply (wherever required) | As per Contractor's Standard practice. |

Notes :-

1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

6.00.00 **SOLENOID VALVES**

Solenoid valves shall fulfill the following requirements: -

a) Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.)

b) Power supply 24V DC.

c) Plug in connector connection.

d) Insulation : Class "H"

7.00.00 **Limit switches**

e) Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55.

8.00.00 **SPECIFICATION FOR CORIOLIS FLOW TRANSMITTER**

| | |
|---|---|
| Type | Coriolis |
| Material of Wetted Parts | 316 SS |
| Material of Housing | 304L SS |
| Accuracy | ± 0.2% of Rate |
| Repeatability | ± 0.1% of Rate |

| | | |
|---|---|---|
| | Output | 4-20 mA DC, HART Compatible |
| | Power Supply | 230 VAC or 24VDC operated |
| | Process Temperature range | 0-200 degree Celsius |
| | Others | Drain / purging arrangement shall be provided as per standard practice. |
| | Viscosity range of Fluid | 0-500cst for HFO |

The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer's approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer's approval.

9.00.00 **SPECIFICATION FOR FLOW ELEMENTS**

9.01.00 **Orifice Plate**

| Features | Essential/Minimum Requirements |
|---|---|
| Type | Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167 |
| Material | 316 SS |
| Thickness | 3 mm for main pipe diameter up to 300 mm and6 mm for main pipe dia above300 mm. |
| Material of branch pipe | Same as main pipe |
| Root valve type | Globe |
| Root valve material | Same as pipe material |
| Root valve size | 1 / 2 inch or 1 inch (as applicable) |
| Impulse pipe of same material up to root valve | Required |
| Tappings | Flanged weld neck or D & D/2 with 3 pairs of tapping ( as applicable ). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum. |
| Beta Ratio | 0.34 to 0.7 |
| Beta Ratio calculation to be submitted | Yes |
| Assembly drg. and flow Vs DP Curves | Yes |
| Accessories | Root valves, flanges, Vent/drain hole(As required) |

Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.

9.02.00 **Flow Nozzle**

| Features | Essential/Minimum Requirements |
|---|---|
| Type | Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042 |
| Material | 316 SS |
| Thickness | Suitable for intended application. |
| Material of branch pipe | Same as main pipe |
| Root valve type | Globe |
| Root valve material | Same as pipe material |
| Root valve size | 1 inch |
| Impulse pipe of same material up to root valve | Required |
| Tapping | Flanged weld neck or D & D/2 with 3 pairs of tapping ( as applicable ). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum. |
| Beta Ratio | Around 0.7 |
| Beta Ratio calculation to be submitted | Yes |
| Assembly drg. and flow Vs DP Curves | Yes |
| Accessories | Root valves, vent and drain hole. |

Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.

9.03.00 **Venturi (For Liquid applications)**

| Features | Essential/Minimum Requirements |
|---|---|
| Type | Rough Welded (for Pipe dia between 200mm to 1200mm) or Machined (for Pipe dia 50mm to 250mm) as per ISO 5167-4:2003, |
| Material | Same as Main Pipe |
| Thickness | Same as Main Pipe. |
| Root valve type | Globe Type |
| Root valve material | Same as Pipe material |
| Root valve size | 1 inch |
| Impulse pipe of same material up to root valve | Required |
| Tapping | 3 pairs of tappings for each Venturi as per ISO 5167-4:2003, However for some areas like CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum. |
| Beta Ratio | 0.4 to 0.7 |
| Beta Ratio calculation to be Submitted | Yes |
| Assembly drg. and flow Vs DP Curves | Yes |
| Accessories | Root valves, vent and drain hole. |

Contractor shall submit certified flow calculation and differential pressure vs. Flow curves for each element for employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for employer's approval.

9.04.00 **ROTAMETERS**

| Sr. No. | Features | Essential / minimum requirements | |
|---|---|---|---|
| 1. | Type | Variable Area Metal Tube | |
| 2. | Fluid media | Water/oil | |
| 3. | Tube body | SS316 | |
| 4. | Material of float | 316 SS | |
| 5. | Indicator | Linear scale | |

| | | | |
|---|---|---|---|
| 6. | Accessories | Flange, orifice in case of bypass Rota meter (for line size above 100 mm) | |
| 7. | Housing protection class | IP-55 | |
| 8. | Accuracy | ± 2% of measured value. | |

10.00.00 **ANALYSER INSTRUMENTS (OTHER THAN CEMS):**

| Common Requirements | | |
|---|---|---|
| 1 | Output signals | |
| | Analog | 4-20 mA DC galvanically isolated. If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station. |
| | Binary | 2 NO + 2 NC for high alarm |
| 2 | Zero & span Adjustment | To be provided with range selection facility. |
| 3 | Ambient temp. | 50°C |
| 4 | Indication | Digital Alphanumeric Display. Display of reading in engineering units shall be provided. |
| 5 | Enclosure Type/Material | Weather & Dust proof (IP 55) Die cast Aluminium/SS. |
| 6 | Type of Electronics | Microprocessor based with self diagnostic. |
| 7 | Digital Signal transmission | HART / RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for communication with plant control system. |
| 8 | Calibration | Auto & Manual (from Remote) |
| 9 | Power Supply | To be arranged by Contractor subject to Employer's approval. |
| 10. | Others | All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to local junction box are to be provided. |

| | | |
|---|---|---|
| | | All the calibration gases required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas. |
| 11. | Compliance to standards | USEPA, TUV, MCERTS or equivalent standards |
| 12. | Type of Technology | SO2:- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type<br>For Hot-extractive sampling type and Dilution extractive type systems, the entire system including analysers, sample handling/conditioning system etc offered shall be sourced from/assembled at Original Analyser manufacturer(OAM) works |
| 13 | Measurement Range, Tapping point | As per FGD system design and process parameter |

10.01.00 **Specific requirements for Hot-extractive sampling type SO2 analysers**

| **Specification Requirements** | **SO2 Analyser cum monitor (combined)** |
|---|---|
| Type of Instrument | Sampling type - Hot Extractive type |
| Principle of Measurement | Radiation absorption |
| Accuracy | +/- 1% of FS |
| Linearity | +/- 1% of FS |
| Repeatability | $\leq$ 1% of Span |
| Response time(up to 90% of full scale) | $\leq$ 5 secs |
| a) Temperature Drift | +/- 2% / 10 deg.C |
| b) Zero Drift | < 1% span/week |
| c) Span Drift | < 1% measured value/week |
| Operating Temperature Range for probe | 0-300 deg.C |
| Filter | Ceramic 3.5 Micron |
| Accessories for purging system | Purging system including Auto Scavenging facility shall be provided |

| | |
|---|---|
| Sample gas inlet temperature to analyser | Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards**.** |

10.02.00 **Specific requirements for Dilution Extractive type SOx Analsyers**

The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:

| |
|---|
| a) Modular Electronic Design. |
| b) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NOx/CO2/SO2 from air and accumulator |
| c) Self test facility with screen display |
| d) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit |
| e) The following are the minimum requirement for the probe:-<br>• Flange and counter flange for inserting probe<br>• Coarse and Fine filters<br>• Critical orifice<br>• Automatic blow back or purging facility<br>• SS316L probe material |
| f) Further dilution probe controller shall be provided with the ability to control dilution ratio |
| (g) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE. |

| **Specification Requirements** | **SO2 Analsyer** |
|---|---|
| Principle of measurement | Pulsed/UV Fluorescence technology. |
| Probe operating temp | 0-300 deg C |
| Zero drift | <1 ppb/day |
| span drift | +/-1% FS/day |
| Lower detection limit. | <=1.0 ppb |
| Response time(up to 95% of full scale) | 100 sec |
| Accuracy/Precision. | +/- 1% |
| Linearity | +/- 1% Full scale |
| Sample gas inlet temperature to analyser | 5 deg.C - 40 deg.C |

10.03.00 **Specific requirements for In-situ (Path) type SO2 analysers**

| **Specification Requirements** | **SO2 Analyser cum monitor** |
|---|---|
| Principle of Measurement | Differential Optical Absorption Spectroscopy |
| Accuracy | <= 2% of measured value for SO2 |
| Linearity | +/-1% of measurement span |
| Probe Operating Temperature Range | 0 to 300 deg C |
| Accessories for purging system | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. |
| Temperature compensation | Automatic temperature compensation to be provided |

10.04.00 **pH Analyser**

| | | |
|---|---|---|
| **a)** | **Type** | **:** Cell - flow through |
| **b)** | **Accuracy** | **:** < ± 1% of reading |
| **c)** | **Range** | **:** 0 - 14 pH freely programmable (For others) |
| **d)** | **No. of steams** | **:** Single |
| **e)** | **Temp. compensation** | **:** Automatic |

11.00.00 **CONTINUOUS EMISSION MONITORING SYSTEM (CEMS):-**

Continuous Emission Monitoring system consisting of the following equipments (Analysers/monitors) shall be provided for measurement of emissions in stack of each unit:-

1. SO2/NOx Analyser
2. CO analyser
3. CO2 analyser
4. Flue gas Flow Meter
5. Flue gas temperature measurement( As defined under Particulate Emission Analyser)
6. Particulate Emission (Stack Opacity) Analyser
7. Mercury Analyser

The common requirements to be met for all types of analysers are as below. The specific requirements to be met by each type of analyser are detailed in the subsequent clauses.

11.01.00 **Common Requirements for all Analysers**

| | | |
|---|---|---|
| 1 | Output signals | |
| | Analog | 4-20 mA DC galvanically isolated. |
| 2 | Zero & span Adjustment | To be provided for all selectable ranges. |
| 3 | Ambient temp. | 0-50°C unless defined otherwise. |
| 4 | Indication | Digital Alphanumeric Display. Display of reading in engineering units shall be provided. |
| 5 | Analyser enclosure Type/Material | Die cast Aluminium/SS. Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55. |
| 6 | Type of Electronics | Microprocessor based with self diagnostic. |
| 7 | Digital Signal transmission | RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol for bidirectional communication of stack emission data to Employer's cloud server |
| 8 | Calibration | Auto & Manual (from Remote) |
| 9 | Power Supply | To be arranged by Contractor subject to Employer's approval. |
| 10. | Others | I) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to DCS (in respective unit control room) are to be provided by Contractor. |
| | | ii) All the calibration gases required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas. |
| 11 | Location of probe | SO2/NOx/CO/CO2-On stack at approximate elevation of 35 Mtrs.<br>Particulate Emission (Stack Opacity) & Flow measurement -On stack at approximate elevation of 88 Mtrs<br>Mercury:- on stack at 35 Mtrs. |
| 12 | Location of the analysers (other than insitu type)/Analyser Panel. | AT 0' Mtrs near stack for CEMS |
| 13 | Compliance to standards | USEPA, TUV, MCERTS or equivalent standards |
| 14 | Type of Technology | SO2/NOx :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type |

| | | |
|---|---|---|
| | | CO :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type. (can be combined with SO2/NOx)<br>CO2 :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type (can be combined with CO or SO2/NOx above).<br>Stack Opacity :- In-situ (Path)type<br>Note:- For Hot extractive sampling type and Dilution extractive sampling type system – The components involved in sample handling system shall be imported & further, Sample handling system design shall be vetted by Original Analyzer Manufacturer (OAM). Necessary documents shall be furnished during detailed engineering in order to establish the above requirement. Technical expert of OAM shall witness testing of sample handling system and validate it. Alternatively sampling handling system assembled at Original Analyzer manufacturer (OAM) works shall also be accepted. |
| 15 | Contractual conditions for CEMS system | Warranty:- As defined elsewhere in the Contract.<br>Comprehensive Annual Maintenance Contract:-. Refer sub-section-IIC-C& I/ Section-VI/ Part-A. This shall cover total maintenance of all hardware and software related to CEMS and shall include free repair/replacement of all components/cables/equipment etc and Supply of expendable items.<br>Availability of valid data:-AT least 90% of time during warranty and CAMC period. For this purpose, contractor may take necessary steps to ensure availability.<br>Services to be provided during Warranty and CAMC period shall be as per clause no. 2.04.00, 2.05.00 and 2.06.00, Sub-Section-III-C, SECTION-VI, PART-A |

11.02.00 **Specific requirements for Hot-extractive sampling type SO2/NOx, CO2 & CO analysers**

| **Specification Requirements** | **SO2 Analyser and Nox Analyser cum monitor (combined)** | **CO2 ANALYZER** | **CO Analyser** |
|---|---|---|---|
| Type of Instrument | Sampling type - Hot Extractive type | Hot-Extractive | Hot-extractive type |
| Principle of Measurement | Radiation absorption | NDIR absorption | NDIR absorption |
| Measurement Range | 0-300 ppm/ 0-1500 ppm (selectable) | 0 to 40% (selectable) | 0-200 ppm to 0-1000 ppm (selectable) |
| Accuracy | +/- 1% of FS | +/-2% of measured value | +/- 2% of FS |
| Linearity | +/- 1% of FS | +/- 1% of FS | +/- 1% of FS |
| Repeatability | $\leq$ 1% of Span | $\leq$ 0.5% of Span | $\leq$ 1% of Span |

| | | | |
|---|---|---|---|
| Response time(up to 90% of full scale) | ≤ 5 secs | ≤ 5 secs | ≤ 5 secs |
| a) Temperature Drift | +/- 2% / 10 deg.C | +/-1% in 24 hrs | +/- 2% / 10 deg.C |
| b) Zero Drift | < 1% span/week | < 1% span/week | < 2% span/week |
| c) Span Drift | < 1% measured value/week | < 1% measured value/week | < 1% measured value/week |
| Operating Temperature Range for probe | 0-300 deg.C | 0-300 deg.C | 0-300 deg.C |
| Filter | Ceramic 3.5 Micron | Ceramic 3.5 Micron | Ceramic 3.5 Micron |
| Accessories for purging system | Purging system including Auto Scavenging facility shall be provided | Purging system including Auto Scavenging facilityshall be provided | Purging system including Auto Scavenging facility shall be provided |
| Sample gas inlet temperature to analyser | Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards**.** | Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards**.** | Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards**.** |

11.03.00 **Specific requirements for Dilution Extractive type SOx/NOx/CO2 & CO Analsyers**

The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:

| |
|---|
| a) Modular Electronic Design. |
| b) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NOx/CO2/SO2 from air and accumulator |
| c) Self test facility with screen display |
| d) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit |
| e) The following are the minimum requirement for the probe:-<br>• Flange and counter flange for inserting probe |

- Coarse and Fine filters
- Critical orifice
- Automatic blow back or purging facility
- SS316L probe material

f) Further dilution probe controller shall be provided with the ability to control dilution ratio

g) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE.

| **Specification Requirements** | **SO2 Analsyer** | **NOx Analsyer** | **CO2 Analsyer** | **CO Analsyer** |
|---|---|---|---|---|
| Principle of measurement | Pulsed/UV Fluorescence technology. | Chemiluminescence technology. | Gas Filter correlation | Gas Filter Correlation technology |
| Measurement Range | 0-1500 ppm (selectable) | 0-500 ppm (selectable) | 0 to 40% (selectable) | 0-200 ppm to 0-1000 ppm (selectable) |
| Probe operating temp | 0-300 deg C | 0-300 deg C | 0-300 deg C | 0-300 deg.C |
| Zero drift | <1 ppb/day | < 0.5 ppb/day | <=1 ppm/day | <0.1 ppm/day |
| span drift | +/-1% FS/day | +/-1% FS/ day | +/-2% FS/day | +/-1%FS/day |
| Lower detection limit. | <=1.0 ppb | <=0.4 ppb | <=1 ppm | 0.05 ppm |
| Response time(up to 95% of full scale) | 100 sec | 60 sec | 90 sec | 60 sec |
| Accuracy/Precision. | +/- 1% | +/- 1% | +/- 1% | +/- 1% |
| Linearity | +/- 1% Full scale | +/- 1% Full scale | +/- 1.5% Full scale | +/- 1% of Full scale |
| Sample gas inlet temperature to analyser | 5 deg.C - 40 deg.C | 5 deg.C - 40 deg.C | 5 deg.C - 40 deg.C | 5 deg.- 40 deg.C |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

11.04.00 **Specific requirements for In-situ (Path) type SO2/NOx, CO2 & CO analysers**

| Specification Requirements | CO Analyser cum monitor | SO2/NOx Analyser cum monitor | CO2 Analyser cum monitor |
|---|---|---|---|
| Principle of Measurement | IR absorption | Differential Optical Absorption Spectroscopy | Differential Optical Absorption Spectroscopy |
| Measurement Range | 0-200, 0-1000 ppm, (selectable) | 0-300 ppm/ 0-1500 ppm (selectable) | 0-40% (selectable) |
| Accuracy | +/- 5% of FS | <= 2% of measured value for SO2 and +/- 5% for NO2 | |
| Linearity | +/-2% of FS | +/-1% of measurement span | +/-1% of measurement span |
| Repeatability | $\leq$ 0.5% of Span | | |
| Response time(up to 90% of full scale) | $\leq$ 5 sec | | |
| a) Temperature Drift | Automatic temp compensation | | |
| b) Zero Drift | <1% span/week | | |
| c) Span Drift | < 1% measured value / week | | |
| Probe Operating Temperature Range | 0 to 300 deg C | 0 to 300 deg C | 0 to 300 deg C |
| Accessories for purging system | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. |
| Temperature compensation | Automatic temperature compensation to be provided | Automatic temperature compensation to be provided | Automatic temperature compensation to be provided |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

11.05.00 **Specific requirements for Particulate Emission (Dust density Stack Opacity) monitor**

| Specification Requirements | PARTICULATE EMISSION (Dust density Stack Opacity) monitor |
|---|---|
| Type of Instrument * | In-Situ dry type visible light (through LED) stack |
| Principle of Measurement | Transmission and absorption |
| Measurement Range | 0 to 999mg/m2, (Programmable) |
| Accuracy | 2% of FS |
| Linearity | +/- 1% of FS |
| Repeatability | ≤ 1% of Span |
| Response time(up to 90% of full scale) | ≤ 5 sec |
| a) Temperature Drift | +/-1% in 24 hrs |
| b) Zero Drift | < 1% span/week |
| c) Span Drift | < 1% measured value/week |
| Operating Temperature Range for probe | 0-300 deg.C |
| Filter | To be provided |
| Accessories purging system | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. |
| Temperature compensation/measurement | Temperature compensation to be provided. Further, additional 4-20 mA signal for stack temperature through temperature transmitter shall be provided and connected to DDCMIS. |

Note: * For stack dust density measurement - In case specified type of instrument is not suitable for the actual flue gas parameters at chimney, the contractor can provide suitable instrument based on other proven technology for the intended application & meeting the other technical requirements specified above, subject to Employer's approval during detailed engineering. Contractor shall furnish necessary documents in support of suitability and provenness of instruments for envisaged application.

11.06.00 **Specific requirements for Continuous On-line Mercury Analyser**

| S.NO. | PARAMETER | DETAILS |
|---|---|---|
| 1 | Measurement Principle | Atomic Absorption Spectrometry/ Atomic Fluorescence spectrometry. |
| 2 | Range | 0-100 microgram/Nm3 |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

11.07.00 **ULTRASONIC FLOW METER FOR FLUE GAS FLOW IN STACK**

| | |
|---|---|
| Type | Transit time Ultrasonic meter |
| Mounting Style | Transducers on the duct/stack |
| Transducer type and material | Single pair of Corrosion resistant material to be provided |
| Zero and Span adjustment | To be provided |
| Flow measurement | Instantaneous Flow rate as well as totalized flow |
| Power supply Distribution | to be arranged by the Contractor from Employer's terminal point. |
| Outputs :<br>Analog<br>Datalink | <br>4-20 mA DC galvanically isolated.<br>RS 232/RS485/Modbus protocol/ Ethernet TCP/IP protocol for bidirectional communication link with Employer's cloud server |
| Display/Indication | Flow meter with LCD screen backlight based local display and keypad . If required, transmitter shall be suitably located away from the sensor for better access and visibility. |
| Recording / Totalizing/Logging Facilities | To be provided |
| Diagnostics | False signal tolerance , power supply failure etc |
| Protection class | IP-65 or better |
| Ambient temperature | -20 deg to +60 deg C |
| Accuracy | <+/- 2% |
| Electrical connection | Plug and socket |
| Accessories | All mounting hardware required like clamping fixtures, mechanism to remove the transducers online, interconnecting cables to DDCMIS, cables, flexible conduits, junction boxes etc<br>Purging arrangement for Cleaning sensors to be provided. Material of all fittings shall be SS 316. |
| Software features | Compensation for temperature and pressure and any cross path errors.<br>Programming, configuration, shall be possible from front panel. |

**NOTES:-**

01. Hot extractive sampling type/ Dilution extractive type systems shall be provided with dual sample probes along with all required accessories such as redundant

heavy duty pumps with continuous rated motors, moisture detection facility, pre-fabricated heated (for sampling type only) sample lines from probes to analyser panel, solenoid valves, filters, coolers along with level switch in gas coolers for auto draining purpose and flow meter etc as applicable.

02. Not used

03. If the SOx, NOx, CO2 & CO ( if sampling/dilution type) analyzers do not meet the environmental conditions specified at cl. 4.00.00 of Sub Sec IIIC-01, Section-VI, Part-B, panel AC shall be provided in analyzer cabinets to meet the requirement.

04. Not used

11.08.00 Connectivity with DDCMIS and provision for bidirectional communication with Employer's Cloud Server

1. 4-20mA signals from all the above analysers/flow meters/temperature transmitter to DCS of respective unit.

2. RS232/ RS485 Modbus protocol/ Ethernet TCIP/IP protocol for bidirectional communication with Employer's Cloud Server as defined in Sub-section-IIC-C&I/ Section-VI/ Part-A.

All the accessories and cables required for connecting Analysers outputs to DCS and provision of bidirectional communication as defined above shall be provided by Contractor on as required basis.

12.00.00 **SPECIFICATION OF ANALYSERS**

12.01.00 **Common Requirements**

| | | |
|---|---|---|
| **1.** | Type of electronics | Microprocessor based |
| 2. | Zero & span Adjustment | To be provided |
| 3. | Ambient temp. | 50°C |
| 4. | Display | LCD |
| 5. | Enclosure Type / Material | Weather and Dust proof (IP 55), Die cast aluminum with corrosion resistant epoxy coating for external field mounting analysers |
| 6. | Output signals Analog | 4-20 mA DC |
| 7. | Error / fault Diagnostic | To be provided. |
| 8. | Power supply | The power supply to all the analyzers / monitors shall be supplied by contractor |

| | | |
|---|---|---|
| | | with all necessary switches, fuses, wiring / cabling and other required accessories etc. for distribution to individual requirements. |
| | 9. Load | 500 Ohms minimum |
| | 10. Mounting | All mounting arrangements for the sensors and the monitors are to be provided by the Contractor. SWAS instruments to be mounted in the panel except Hotwell analysers.<br>For the same and other field application free standing cabinet(s) / panel / rack is to be provided by the Contractor for mounting the analysers / transmitters / meters as applicable due to environment. |
| | 11. Other Requirements | All chemical reagents required for silica, phosphate, sodium, chloride, residual chlorine and hydrazine analyzers for 12 months operation is to be supplied in phased manner depending on shelf life. |

12.02.00 **Conductivity Analyser**

| | |
|---|---|
| 1. Type | Continuous flow through type |
| 2. Range | • As per the process requirement, Freely programmable<br>• 0-2500 ppm for Total Dissolved Solids (TDS). |
| 3. Accuracy | <=+/- 1 % of reading |
| 4. Temperature Compensation | Automatic |
| 5. Response time | <=5Sec |
| 6. No. of Streams | Single |
| 7. Other | Wherever cation conductivity measurement have been specified dual cation exchange column shall be provided. |

12.03.00 **pH analyser**

| | |
|---|---|
| 1. Type | Continuous flow through type |
| 2. Range | 0 - 14 pH freely programmable |
| 3. Accuracy | < ± 1% of reading |
| 4. Temperature Compensation | Automatic |
| 5. No. of Streams | Single |

12.04.00 **Turbidity Analyser**

| | |
|---|---|
| 1. Type | Light reflection principle |
| 2. Range | 0-100, 0-200 NTU programmable |
| 3. Accuracy | <= 2% for range 0 – 50 NTU<br><= 5% for range 50 - 200 NTU |
| 4. Response time (90 % of full scale) | <= 5 minutes. |
| 5. No. of Streams | Single |

12.05.00 **Phosphate Analyser**

| | |
|---|---|
| 1. Type | Colorimetric |
| 2. Range | 0-10 ppm freely programmable |
| 3. Accuracy | <= +/- 5 % of reading |
| 4. Temperature Compensation | Automatic, however, If the measurement technique is temperature insensitive within the range or if the temperature is closely maintained at a set value, the same are also acceptable. |
| 5. Response time | <= 15 min |
| 6. Sample Flow | 1000 ml/min (Max) |

12.06.00 **Chloride Analyser**

| | |
|---|---|
| 1. Type | Continuous Flow through type with chloride and sulphate Responsive electrodes |
| 2. Range | 0-1000 ppb freely programmable |
| 3. Accuracy | <= +/- 5 % of reading |
| 4. Temperature Compensation | Automatic |
| 5. No. of Streams | Single |

12.07.00 **Silica Analyser**

| | |
|---|---|
| 1. Type | Continuous Colorimetric Type |
| 2. Range | 0-50, 0-100, 0-500 ppb freely programmable |
| 3. Accuracy | <= +/- 5 % of reading |
| 4. Temperature Compensation | Automatic, however, If the measurement technique is temperature insensitive within the range or if the temperature is closely maintained at a set value, the same are also acceptable. |
| 5. Response time | <= 15 min |
| 6. No. of Streams | Multi Stream with at least one stream as spare. |
| 7. Sample Flow | 50-150 ml/min |
| 8. Other requirement | Sample shut off solenoid valve to be provided |

12.08.00 **Sodium Analyser**

| | |
|---|---|
| 1. Type | Continuous Flow Through Sample |
| 2. Range | 0-1, 0-10, 0-200, 0-2000 ppb freely programmable |
| 3. Accuracy | <= +/- 10 % of reading |
| 4. Temperature Compensation | Automatic |
| 5. Response time | <= 4 min |
| 6. No. of Streams | Multi Stream with at least one stream as spare. |

| | |
|---|---|
| 7. Sample Flow | 125 ml/min (max) |

12.09.00 **Hydrazine Analyser**

| | |
|---|---|
| 1. Type | Automatic Continuous Electrochemical Type |
| 2. Range | 0-50, 0-100, 0-500 ppb freely programmable |
| 3. Accuracy | <= +/- 5 % of full scale |
| 4. Temperature Compensation | Automatic |
| 5. Response time | <= 3 min |
| 6. No. of Streams | Single |
| 7. Sample Flow | 500 ml/min (max) |
| 8. Other requirement | Sample shut off solenoid valve to be provided |

12.10.00 **Dissolved O2 Analyser**

| | |
|---|---|
| 1. Type | Continuous Flow Through Sample |
| 2. Range | 0-20, 0-200 ppb freely programmable |
| 3. Accuracy | <= +/- 5 % of full scale |
| 4. Temperature Compensation | Automatic |
| 5. Response time | <= 30 sec |
| 6. No. of Streams | One single stream, one switchable between two. |
| 7. Sample Flow | 500 ml/min (max) |

12.11.00 **Residual Chlorine Analyser**

The analyser shall comply with the following specification requirements, as a Minimum

| | |
|---|---|
| 1. Type | Amperometric type |
| 2. Range | 0 to 20.0 mg/L (ppm) |
| 3. Accuracy | <=+/- 5 % ( see Note – 1) |
| **4. Alarm annunciation** | High and low alarms to be provided on panel and shall be field adjustable. |
| 5. **Calibration** | Zero and span adjustment facility to be provided. Final calibration adjustments of the analyser to be done at site and duly verified by titration. Temperature compensation range 0 to 50 deg.C. |
| 6. Connections | All connections for sampling drain etc. to be provided. |
| 7. Cabling | All field cabling power cables and panel wiring etc., to be provided. |
| **8. Electrodes** | Platinum/Gold and copper electrodes shall be provided with cell cleaning system. |

**Note-1:** The measurement accuracy shall not be affected by presence of treatment chemicals as chromates, phosphates, de-former highly polluted water, change in temperature etc.

**Note-2:** Circulating water as sample to residual chlorine analyser shall be taken from hot circulating water pipe work before entry to cooling towers. Exact location and layout of sampling arrangement shall be finalized during detailed Engg. stage. Bidder shall provide necessary pumping system (with 100% standby) for meeting the analyser requirements, if needed. All the drains shall be terminated up to the nearest Employer's plant drainage system.

13.00.00 **Parshall Flume**

Parshall Flume shall be provided wherever indicated in P&IDS. The Bidder shall provide all the control and Instrument devices including primary sensors, transmitters, flow indicator cum integrator / totaliser and shall include all required accessories for the flow measurement of raw water through the clarifier. The system shall be of reputed make and acceptable to the owner.

Level measurement shall be based on ultrasonic/radan technology. The flow compensation is to be implemented in the transmitter itself. The transmitter shall provide 4-20 mA DC in direct proportion to flow and shall be able to drive a load impedance of 500 ohms minimum. Accuracy shall be +/- 1 % or better.

All the mounting hardware and accessories required for erection and commissioning of the same are to be provided by the contractor. Mounting fittings material shall be SS316. All weather canopy is to be provided for electronics/sensor to protect the same from The Type makes and models no. shall be subject to Owner's approval.

14.00.00 **Electronic Flow-Meter**

Electronic Flow-meters shall be provided where ever indicated in the P&IDs.
The electronic flow meter shall include flow sensor and flow indicator cum integrator/totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore ultrasonic/electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner.
The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feedback on satisfactory performance of the instruments.

The flow meter shall meet or exceed the following requirement:

| | |
|---|---|
| (a) Output : | 4-20 mA DC Isolated output |
| (b) Accuracy : | ± 0.5% of calibrated span or better * |
| (c) Repeatability : | ± 0.2% of calibrated span or better |
| (d) Ambient Temp. & Humidity : | 4 deg.C to 55 deg.C.<br>5% to 100% RH |
| (e) Power Supply : | 240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arranged by the contractor. |
| (f) Protection class : | IP-55 |
| (g) Flow tube | SS304 |
| (h) liner | Hard Rubber |

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser / integrator to get the daily and monthly discharge as stated above.

# SUB-SECTION-III-C3

# PROCESS CONNECTION AND PIPING

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

## PROCESS CONNECTION AND PIPING

1.00.00 **PROCESS CONNECTION PIPING**

1.01.00 The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section on as required basis for the connection of all instruments and control equipments of entire plant.

1.01.01 **IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS**

1.01.02 All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The size of impulse pipe shall be ½" for Steam & Water Application and ¾" for Air & Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:

| | |
|---|---|
| Impulse Pipes, Tubes (Material, Rating) | ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70 |
| Valves (Material, Pr. Class, Size) | ASTM A182/ASTM A105 as per ASME 16.34 |
| Fittings (Size, Rating, Material) | ANSI B31.1, ANSI B31.1a, ASME B16.11-2009 |
| Installation Schemes | BS 6739-2009, ANSI/ISA 77.70 |

Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm$^2$ or Temp>280 $^o$C. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.

1.01.03 The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:

| Manifold | Application/Measurement |
|---|---|
| 2 Valve | Pressure measurements using pressure transmitters/pressure switches |
| 3 Valve | Pressure measurements using differential pressure transmitter/ switches |
| 5 Valve | Differential Pressure, Flow and Level Measurements |

For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .

2.00.00 **AIR SUPPLY PIPING**

2.01.01 All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.

2.02.00 Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.

2.03.00 The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports. |
| 2.04.00 | The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location. |
| 2.05.00 | All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch. |
| 2.06.00 | Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering. |
| 3.00.00 | **INSTALLATION AND ROUTING** |
| 3.01.01 | All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe form the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.<br><br>Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes. |
| 4.00.00 | **SHOP AND SITE TESTS** |
| 4.01.01 | The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-IIIE-04 (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan. |
| 4.01.02 | Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1. |
| 5.00.00 | **LOCAL INSTRUMENT ENCLOSURE AND RACKS**<br><br>All transmitters, switches etc. for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant and (ii) In local instrument racks in case of covered areas. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor. The GA of LIR shall be similar to LIE except for front/rear doors and side panels. |

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|---|---|

The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55.

The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.

The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.

Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.

**5.01.00** ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS

All Dual Input temperature transmitters for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant and (ii) Racks in case of covered areas. Integral JB shall be provided with each Enclosure and Rack.

The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance.

Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55.

Enclosure and Racks shall be free standing type.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein.

Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.

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|---|---|
| **6.00.00** | **INSTALLATION OF OTHER INSTRUMENTS:**<br><br>For installation and routing of other field mounted instruments which are not covered in Cl. No. 5.00.00, please refer Cl. No 52.04.00(J) of Section-VI, Part-D, Erection Conditions of Contract (ECC) of Technical Specifications. |

# SUB-SECTION-III-C4

# INSTRUMENTATION CABLES

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

**1.00.00** **INSTRUMENTATION CABLE, CONTROL & POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYs ETC)**

**1.01.00** **General requirements**

1.01.01 All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.

1.01.02 The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope and ensuring completeness of the control system.

1.01.03 Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.

1.01.04 Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.

1.01.05 Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.

1.01.06 Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sum price without any further cost implication to the Employer.

**2.00.00** **SPECIFICATION OF INSTRUMENTATION CABLE**

**2.01.00** **Common Requirements**

| S. No. | Property | Requirement |
|---|---|---|
| 1 | Operating Voltage | 225 V (peak value) |
| 2. | Codes and standard | All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification. |
| 3. | Continuous operation suitability | At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables. |

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|---|---|

| S. No. | Property | Requirement |
|---|---|---|
| 4. | Marking :- a.*Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath.*<br><br>*b.*Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable<br><br>c.Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath. | |
| 5. | Allowable Tolerance on overall diameter | +/- 2 mm (maximum) over the declared value in data sheet |
| 6. | Variation in diameter | Not more than 1.0 mm throughout the length of cable. |
| 7. | Ovality at any cross-section | Not more than 1.0 mm |
| 8. | CAGE-CLAMP suitability | To be provided |
| 9. | Color | The outer sheath shall be of blue color. |
| 10. | Others | Repaired cables shall not be acceptable. |

**2.02.00 Specific Requirements**

| Specification Requirements | Type-A cable | Type-B cable | Type F & G cable | Type-C cable |
|---|---|---|---|---|
| **A. CONDUCTORS** | | | | |
| Cross section area | 0.5 sq. mm | | | |
| Conductor material | ANSI type KX | ANSI type SX | Annealed bare copper | ANSI type KX |
| Colour code | Yellow-Red | Black-Red | As per VDE-815 | Yellow-Red |
| Conductor Grade | As per ANSI MC 96.1 | | Electrolytic | As per ANSI MC 96.1 |
| No & dia of strands | 7x0.3 mm (nom) | | | |
| No. of Pairs | 2 | 2 | 2/4/8/12/16/24 / 48 | 2 |

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|---|---|

| Specification Requirements | Type-A cable | Type-B cable | Type F & G cable | Type-C cable |
|---|---|---|---|---|
| Max. conductor loop resistance per Km (in ohm) at 20 deg. C | As per ANSI MC 96.1 | | 73.4 | As per ANSI MC 96.1 |
| Reference Standard | As per ANSI MC 96.1 | | VDE : 0815 | As per ANSI MC 96.1 |
| **B. INSULATION** | | | | |
| Material | Extruded PVC type YI 3 | | | Teflon (i.e. extruded FEP) |
| Thickness in mm (Min/Max) | 0.25/0.35 | | | 0.4 / 0.50 (nominal) |
| Volume Resistivity (Min) in ohm-cm | 1 x $10^{14}$ at 20 deg. C & 1x$10^{11}$ at 70 deg. C. | | | 2.8x $10^{14}$ at 20 deg. C & 2x$10^{11}$ at 205 deg. C. |
| **C. PAIRING & TWISTING** | | | | |
| Max. lay of pairs (mm) | 50 | | | |
| Single layer of binder tape on each pair provided | Each core printed with number or Numbered binder tape to be provided on each pair | | Yes | Each core printed with number or Numbered binder tape to be provided on each pair |
| Bunch ( Unit Formation) for more than 4P | N.A | | To be provided | N.A |
| Conductor /pair identification as per VDE0815 | N.A. | | To be provided | N.A. |
| **D. SHIELDING** | | | | |
| Type of shielding | Al-Mylar tape | | | |
| Individual pair shielding | No | | To be provided for F-type cable | No |
| Minimum thickness of Individual pair shielding | No | | 0.028mm (28 micron) | No |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

| Specification Requirements | Type-A cable | Type-B cable | Type F & G cable | Type-C cable |
|---|---|---|---|---|
| Overall cable assembly shielding | To be provided | | | |
| Minimum thickness of Overall cable assembly shielding | 0.055 mm (55 micron) | | | |
| Coverage / Overlapping | 100% / 20% | | | |
| Drain wire provided for individual shield | N.A. | | Yes (for F-type)<br>Size- 0.5 sqmm<br>No of strands-7<br>Dia of strands- 0.3mm<br>Annealed Tin coated copper | N.A. |
| Drain wire provided for overall shield | Yes, Size- 0.5 sqmm,No of strands-7,Dia of strands-0.3mm,Annealed Tin coated copper | | | |
| **E. FILLERS** (if applicable) | | | | |
| Non-hygroscopic, flame retardant | To be provided | | | |
| **F. OUTER SHEATH** | | | | |
| Material | Extruded PVC compound YM1 with FRLS properties | | | Teflon (i.e. extruded FRP) |
| Minimum Thickness at any point | 1.8 mm | | | 0.4 mm |
| Nominal Thickness at any point | >1.8 mm | | | 0.5 mm |
| Resistant to water, fungus, termite & rodent attack | Required | | | |
| Minimum Oxygen index as per ASTMD-2863 | 29 % | | | N.A. |
| Minimum Temperature index as per ASTMD-2863 | 250 deg.C | | | N.A. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

| Specification Requirements | Type-A cable | Type-B cable | Type F & G cable | Type-C cable |
|---|---|---|---|---|
| Maximum Acid gas generation by weight as per IEC-60754-1 | 20% | | | N.A. |
| Maximum Smoke Density Rating as per ASTMD-2843 | 60%<br><br>(defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843) | | | N.A. |
| Reference standard | VDE207 Part 5,VDE-816 | | | VDE207 Part 6<br>ASTM D2116 |
| **G. Electrical Parameters** | | | | |
| Mutual Capacitance Between Conductors At 0.8 Khz (Max.) | 200 nF/km | | 120 nF/km for F type<br><br>100 nF/km for G-type | 200 nF/km |
| Insulation Resistance (Min.) | 100 M Ohm/Km | | | |
| Cross Talk Figure (Min.) At 0.8 Khz | 60 dB | | 60 dB | 60dB |
| Characteristic Impedance (Max) At 1 Khz | N.A. | | 320 OHM FOR F-TYPE 340 OHM FOR G-TYPE | N.A. |
| Attenuation Figure At 1 Khz (Max) | N.A. | | 1.2 db/km | N.A. |
| **H. COMPLETE CABLE** | | | | |
| Complete Cable assembly | Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3. | | | N.A. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

| Specification Requirements | Type-A cable | Type-B cable | Type F & G cable | Type-C cable |
|---|---|---|---|---|
| Flammability | Shall pass flammability as per IEEE-383 read in conjunction to this specification | | | As per manufacturer's standard subject to employer's approval |
| **I. CABLE DRUM** | | | | |
| Type | Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to entire drum) or steel drum. | | | |
| Length | 1000 m ± 5% for up to & including 12 pairs<br>500 m ± 5% for above12 pairs | | | |

Note: Heat resistant instrumentation cable shall have same specification as of G/F type instrumentation cable as specified above, except that insulation and outer sheath material shall be Teflon and cable shall be suitable for continuous operation at 205 Deg. C

**3.00.00 SPECIFICATION OF OPTICAL FIBER CABLES (OFC)**

3.01.00 Optic Fiber cable shall be 4/8/12 core, Electrolytically chrome plated corrugated steel taped (ECCST), fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter.

3.02.00 The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Dielectric central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be – 20 deg. C to 70 deg.C

3.03.00 All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.

3.04.00 Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.

3.05.00 Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.

3.06.00 Spliced / Repaired cables are not acceptable.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

3.07.00 Penetration of water resistance and impact resistance shall be as per IEC standard.

**4.00.00 SPCIFICATION OF CONTROL & POWER SUPPLY CABLES**

Refer Electrical sub-sections

**5.00.00 INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY**

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.

TABLE A: CABLE TERMINATION TO BE FOLLOWED

| Application | | Type Of Termination | | Type Of Cable |
|---|---|---|---|---|
| **FROM (A)** | **TO (B)** | **END A** | **END B** | |
| Valves/dampers drives (Integral Junction box) | Marshalling / Marshalling – cum Termination Cubicle / local group JB | Plug in connector | Post mount cage clamp type. | G |
| Transmitters, Process Actuated switches mounted in LIE/LIR | Integral Junction box of LIE/LIR | Plug in connector | Cage clamp (Rail mount) type. | F,G |
| RTD heads | Local junction box | Plug in connector | Cage clamp (Rail mount) type. | F |
| Thermocouple | Local junction box / CJC box (if applicable) | Plug in connector | Cage clamp (Rail mount) type. | A, B, C* |
| Other Field mounted Instrument | Local JB / Group JB | Plug in connector | Cage clamp (Rail mount) type. | F,G |
| RTD | Temperature transmitter | Plug in connector | Screwed, Cage clamp type | F |
| Thermocouple | Temperature transmitter | Plug in connector | Screwed, Cage clamp type | A, B, C* |
| Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR | Group JB | Cage clamp (Rail mount) type. | Cage clamp (Rail mount) type. | F,G |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

| Application | | Type Of Termination | | Type Of Cable |
|---|---|---|---|---|
| **FROM (A)** | **TO (B)** | **END A** | **END B** | |
| Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR | Marshalling / Marshalling – cum Termination Cubicle | Cage clamp (Rail mount) type. | Cage clamp (Post mounted) type. | F,G |
| Marshalling cubicle/ Termination Cabinet | Electronic system cabinet | Cage clamp (Post mounted) type. | Plug-in connector / other system as per Mfr.'s Standard | Internal wiring |
| Marshalling/ Termination System Cabinets | UCD mounted equipments | Cage clamp (Post mounted) type. | Plug in connector / Cage clamp type (rail mounted). | F,G (with plug-in connector at one end) |
| DDCMIS/PLC cabinets | PC, Printers etc. | Plug in connector | Plug in connector | Mfr.'s Standard |

Notes

1 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables which shall be as per manufacturer's standard.

2 For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.

3 * For high temperature applications only.

4 . For connection between field/JB and DDCMIS marshalling cabinet

Minimum 4 pair instrumentation cable shall be used.

5 All the spare cores of instrumentation cable have to be terminated in Marshalling cabinets/ DCS panel end.

6 Not used.

**6.00.00 TERMINAL BLOCKS**

6.01.00 All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post

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| | mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval. |
| 6.02.00 | All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc. |
| 6.03.00 | The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks. |
| 6.04.00 | For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065. |
| 6.05.00 | The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls. |
| **7.00.00** | **INTERNAL PANELS/ SYSTEM CABINETS WIRING** |
| 7.01.00 | Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815. |
| 7.02.00 | All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule. |
| 7.03.00 | All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points. |
| 7.04.00 | All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables. |
| 7.05.00 | All the special tools as may be required for solder less connections shall be provided by Bidder. |
| 7.06.00 | Wire sizes to be utilised for internal wiring. |

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| (i) | Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system. | 0.5 Sq.mm. |
| (ii) | Power supply and internal illumination. | 2.5Sq.mm. minimum (shall be as per load requirement.) |

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| **8.00.00** | **INSTRUMENTATION CABLE INSTALLATION AND ROUTING** |
| 8.01.00 | All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer. |

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8.02.00 Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:

| | | |
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| From 11 kV/6.6 kV/3.3 kV tray system | - | 914 mm |
| From 415V tray system | - | 610 mm |
| From control cable tray system | - | 305 mm |

8.03.00 Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.

8.04.00 Not in use

8.05.00 The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.

**9.00.00 CABLE LAYING AND ACCESSORIES**

9.01.00 CABLE LAYING

1 Cables shall be laid strictly in line with cable schedule.

2 Identification tags for cables.

Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.

3 Cable tray numbering and marking.

To be provided at every 10m and at each end of cable way & branch connection.

4 No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.

5 Buried cable protection

With concrete slabs; Route markers at every 20 Meters along the route & at every bend.

6 Road Crossings

Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between

- HT power & LT power cables,
- LT power & LT control/instrumentation cables,

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Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.

7 Segregation (physical isolation to prevent fire jumping)

a All cable associated with the unit shall be segregated from cables of other Units.

b Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire.

8 Cable clamping

All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.

9 Optical fiber cables ( OFCs) :

Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure

**Inside Building Area – to be laid on separate cable sub-trays**

While buried- in separate burried trench approx.1.0 meter depth, to be laid in 2" rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor;

While crossing roads - to be laid in GI/ rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete;

While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe.

10 **Laying of Network Cable (UTP/STP) :**

**Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure.**

**Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.**

9.02.00 Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.

9.03.00 Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.

9.04.00 The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests.

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| 9.05.00 | The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor. | |
| **10.00.00** | **FIELD MOUNTED LOCAL JUNCTION BOXES** | |
| | (i) No. of ways | 12/24/36/48/64/72/96/128 with 20% spares terminals. |
| | (ii) Material and Thickness | 4mm thick Fiberglass Reinforced Polyester (FRP). |
| | (iii) Type | Screwed at all four corners for door. Door gasket shall be of synthetic rubber. |
| | (iv) Mounting clamps and accessories | Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply. |
| | (v) Type of terminal blocks | Rail mounted cage-clamp type suitable for conductor size upto 2.5 $mm^2$. A M6 earthing stud shall be provided. |
| | (vi) Protection Class | IP: 55 minimum for indoor & IP-65 minimum for outdoor applications. |
| | (vii) Grounding | To be provided. |
| | (viii) Color | RAL 7035 |
| **11.00.00** | **CONDUITS** | |
| 11.01.00 | Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant **terne coated steel** with , water leak, fire and rust proof protected *for the areas of* Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's .<br>*And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.* The temperature rating of flexible conduit shall be suitable for actual application. | |
| 11.02.00 | All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied. | |
| 11.03.00 | Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification. | |
| 11.04.00 | Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be | |

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| | utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits. |
| 11.05.00 | Conduits shall be securely fastened to all boxes and cabinets. |
| **12.00.00** | **CABLE SUB-TRAY & SUPPORT** |
| 12.01.00 | The cable sub-trays and the supporting system, to be generally used between Local/Group JBs and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route). |
| 12.02.00 | The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded. |

# SUB-SECTION-III-C5

# PLC BASED CONTROL SYSTEM

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## PLC BASED CONTROL SYSTEM

**1.00.00 CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY PACKAGES**

1.01.00 Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under scope part at III C, Part-A, Section VI.

1.02.00 The quantity of instruments for each plant auxiliary system shall be as per tender P&ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all instruments and devices, which are needed for the completeness of the plant auxiliary system/equipment, supplied by the Contractor, even if the same is not specifically appearing in the P&ID.

1.03.00 All instruments and control equipments like primary and secondary instruments etc. shall meet the requirements specified in Sub-Section - MEAS INST, Part-B, Section VI. In addition, all electrical instrument devices like switches/ transmitters/ controllers/analyzers/solenoid valves which are located in the field/hazardous locations shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.

1.04.00 Contractor shall provide independent control systems for safe, efficient and reliable operation of each of the plant auxiliary systems. The type of control system shall be as indicated under scope part at III C, Part-A, Section VI.

1.05.00 ON/OFF control, indication, annunciation of incomers and bus-coupler (even if they are not in the scope of the contractor) are also to be performed from Contractor's Control System for each of the plant auxiliary system as applicable.

1.06.00 It shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller module without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line

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| | removal/insertion of controller, I/O modules shall in no way jeopardize safety of plant and personnel. |
| 1.07.00 | The control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardized. Control system shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuit/short circuit, instrument air supply failure etc. On any of these failures the controlled equipment/parameter shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalised during detailed engineering. System shall be designed such that there will be no upset when Power is restored. |
| 1.08.00 | The Control system shall include on-line self-surveillance, monitoring and diagnostic facility giving the details of the fault on the Human Machine Interface System (HMIS). The faults to be reported shall include fault in main & standby power supplies, sensor fault, Input/ Output card failure, Memory Status, Controller fault, failure of Communication/ Network links to PLCs, LAN etc. These faults shall be reported as color change on system status display and as messages on HMIS as well as through local indication on the faulty module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place. |
| 1.09.00 | The Control system shall be located in Air conditioned area. However the referred control system shall be designed to operate in non-air conditioned area also and shall meet the minimum requirements as specified below. |
| 1.10.00 | Also refer configuration diagram for PLC based off-site control system, drawing no. 0000-151-POI-A-013. |
| **2.00.00** | **PROGRAMMABLE LOGIC BASED CONTROL SYSTEM** |
| **2.01.00** | **PLC PROCESSOR** |
| | The processor unit shall be capable of executing the following functions:- |
| | a Receiving binary and analog signals from the field and providing command output to MCC/SWGR/Drive etc. through Input / Output modules and operator initiated commands from HMIS / control panel. |
| | b Implementing all logic functions for control, protection and annunciation of the equipment and systems. |

c Implementing modulating control function for certain application as specified elsewhere in the specification.

d Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc.

e Performing self-monitoring and diagnostic functions.

2.02.00 Wherever Dual processor based PLC system has been specified, each PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete plant operation automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor.

Wherever multiple functional groups have been specified/ required, the above requirements are applicable for each functional group.

2.03.00 The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.

2.04.00 Priority of different commands shall be as follows:

2.04.01 Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.

2.04.02 A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.

**2.05.00 HUMAN MACHINE INTERFACE SYSTEM (HMIS)**

2.05.01 Operator work station (OWS) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC and the Human Machine Interface

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| | System. It shall basically perform the following functions. In case the PC based OWS can not be used as programming station of the PLC and the Human Machine Interface System, then separate PC based programming station shall be provided. |
| 2.05.02 | Operator shall be able to access all control/information related data under all operating conditions including a single processor/computer failure in the HMIS. |
| 2.05.03 | All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions. |
| 2.05.04 | The operator functions for each OWS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering. |
| 2.05.05 | The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets. |
| 2.05.06 | The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorized use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as finalised by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator).<br><br>When any drive or sequence is being controlled from one OWS, the system shall inhibit control access of the same drive or sequence from other OWS or Local Control Panel. |

**2.06.00 PROGRAMMING FUNCTIONALITIES**

Programming of the PLC Processor / controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialized language. For example, the programming of PLC shall use either of the following:-

- Flow-chart or block logic representing the instructions graphically.

- Ladder diagrams.

The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc

All programming functionalities shall be password protected to avoid unauthorised modification.

**2.07.00 SOFTWARE REQUIREMENT**

2.07.01 All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.

2.07.02 The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.

2.07.03 Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user friendly programming language & graphic user interface.

2.07.04 All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum.

2.07.05 All application software for PLC system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator

interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided.

2.07.06 The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software so that Employer's engineers can take backup of these software and are able to do modifications at site.

**2.08.00 PARAMETRIC REQUIREMENTS**

The control system shall be designed such that under worst case loading conditions the response time shall not be worst than the following:-

| | | |
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| On/Off Command | - | The response time for screen update after the execution of the control command from the time the command is issued (for example command to start a motor to the time the screen is updated) shall be two seconds (excluding the drive actuation time). |
| Adjustment Command | - | 0.5 to 1 second. |
| On screen Updating | - | 1 second. |
| All Control related displays | - | 1 second. |
| Bar Chart displays | - | 2 to 3 seconds. |
| Plant Mimic displays | - | 2 to 3 seconds. |
| Group review displays | - | 2 to 3 seconds. |
| X-T Plot Displays | - | 1 to 2 seconds. |
| Plant Summary Displays | - | 1 to 2 seconds. |

Even under worst case loading condition of HMIS and system Bus, each HMIS processor shall have 50 % spare time when measured over any one minute period and the system bus shall have at least 50 % spare duty cycle.

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| **3.00.00** | **INPUT/OUTPUT MODULES** |
| 3.00.01 | The PLC system should be designed according to the location of the input/output cabinets as specified. |
| 3.00.02 | Input Output modules, as required in the Control System for all type of field input signals ( 4-20 mA, non change over/change over type of contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24/48 VDC output signals for energising interface relays,4-20 mA output etc.) are to be provided by the Contractor. Contractor to refer drawing no. 0000-999-POI-A-065 for interface/termination requirements of Field Instruments/ Drives. |
| 3.00.03 | Electrical isolation of 1.5KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment. |
| 3.00.04 | The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status. |
| 3.00.05 | Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems. |
| 3.00.06 | All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply. |
| 3.00.07 | The Contractor shall provide the following monitoring features:<br>a Power supply monitoring.<br>b Contact bounce filtering.<br>c Optical isolation between input and output signals with the internal circuits<br>d In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be intimated to the successful Contractor during detailed engineering. |

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| 3.00.08 | Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA at 24 VDC. Analog output modules shall be able to drive an load impedance of 500 Ohms minimum. |
| 3.00.09 | Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware. |
| 3.00.10 | Only one changeover contact shall be provided in MCC for control and interlock requirement. Further multiplication, if required, shall be done by the contractor in PLC system. |
| 3.00.11 | All input fields interrogation voltage shall be 24V DC or 48 V DC. |
| 3.00.12 | In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be decided during detailed engineering) with proper annunciation. |
| 3.01.00 | Wiring Scheme for inputs to control system shall be as follows: |
| 3.01.01 | Input used for interlock/protection shall be dual redundant. Each of the redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement scheme of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group. |
| 3.01.02 | The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows: |
| 3.01.03 | All single analog & binary inputs including the limit switches of valves/dampers MCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules. |
| 3.01.04 | The on-off status of HT drives etc, however, be wired to two input modules in parallel. |
| 3.01.05 | Inputs and Outputs related to each of the redundant drives / equipments ( eg. each of the 3x50 % drives, each of the storage vessel/sump/tank storing same fluid, each of the streams and its related drives etc. ) shall be wired to separate input and output modules. |

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3.02.00 The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers.

3.03.00 The maximum number of inputs/outputs to be connected to each type of module shall be as follows:

| | | |
|---|---|---|
| 1. | Analog input module | 16 |
| 2. | Analog output module | 16 |
| 3. | Binary input module | 32 |
| 4. | Binary output module | 32 |
| 5. | Analog input & output (combined) | 16 |
| 6. | Binary input and output (combined) | 32 |

3.04.00 Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station screens for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be displayed on the screens.

3.05.00 Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant data link to the central PLC system) as specified. These Input/Output modules shall meet the technical requirements as mentioned in the above clauses. Further these Input/Output modules shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Wherever the cable route distance of these I/O cabinets/racks exceeds a distance of 300 meters from the Central PLC, fiber optic data link has to be provided.

**4.00.00 SYSTEM SPARE CAPACITY**

4.01.00 Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:

4.02.00 10% spare channels in input/output modules fully wired up to cabinets TB.

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| 4.03.00 | Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules. Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space. |
| 4.04.00 | Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller. |
| 4.05.00 | The Data communication system shall have the capacity to handle the additions mentioned above. |
| 4.06.00 | Twenty (20) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets. |
| 4.07.00 | The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification. |
| **5.00.00** | **DATA COMMUNICATION SYSTEM (DCS)** |
| 5.01.00 | The Data Communication System shall include a redundant Main System Bus with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non-redundant.<br><br>The DCS shall have the following minimum features :<br><br>a Redundant communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station.<br><br>b The design shall be such as to minimise interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any |

station/module connected to the system bus shall not result in loss of any communication function to and from any other station/module.

c If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility.

d Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed/logged.

e The design and installation of the system bus shall take care of the environmental conditions as applicable.

f Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion.

g Passive coaxial cables or fibre optic cables shall be employed.

The Contractor shall furnish details regarding the communication system like communication protocol, bus utilisation calculations etc.

5.02.00 The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.

**5.03.00 Controls/Open Loop Control System (OLCS) Functions**

5.03.01 These clauses are applicable for all the Binary controls of PLC included in Contractor's Scope including all the control logics of FGD system.

5.03.02 The OLCS shall include sequence control, interlock & protection for various plant auxiliaries/valves/dampers/drives etc. The sequence control shall provide safe and automatic startup and shutdown of FGD system. The interlock and protection system shall ensure safe operation of FGD system at all times and shall automatically shut down FGD system when unsafe conditions arise.

5.03.03 The OLCS shall be arranged in the hierarchical control structure consisting of unit level, group level, subgroup level & drive level (as applicable).

5.03.04 It shall be possible to perform automatic FGD startup & shutdown by issuing minimum number of command from OWS. Thus, the unit level shall control all the Control System Blocks and issue appropriate startup & shutdown commands to various blocks of this Control System and receive corresponding commands/check backs/feedbacks.

5.03.05 The group level shall control a set of functional sub-groups of drives. Appropriate start-up and shut down commands shall be issued to the sub-group control and various check-backs shall be received from sub-groups or drives. Each sub-group shall execute the sequential start-up and shut down programs of a set of inter-related drives along with system interlocks and protections associated with that sub-group as well as basic interlocks and protections related to individual drive falling under that sub-group. The drive level shall accept commands from the sub-groups, push buttons (wherever provided), etc., and transmit them to the respective drive, after taking into account various interlocks and protections and the safety of that particular drive. For HT drive, first-up logic shall be incorporated to indicate the cause of protection/trip.

5.03.06 **Sequence Control**

1 A sequence shall be used to move a set of groups, sub-groups from an initial steady state (for instance 'OFF') to a final steady state (for instance 'ON'). The sequence initiating command for the unit & group level shall be issued from OWS.

2 A sequence shall be made of steps. The steps shall be executed in predetermined order according to logic criteria and monitoring time consisting of the interlock & protection requirements and check back of previous step which shall act as preconditions before the sequence control can execute the command for that step.

3 Each step shall have a "waiting time" implying that the subsequent step would not be executed unless the specified time elapses. A monitoring time shall also be defined as the maximum time required in executing the commands of any step and the time required for appearance of check back signals. In case, this is not completed within the specified time, a message shall be displayed and programme will not proceed further.

4 Manual intervention shall be possible at any stage of operation and the sequence control shall be able to continue at the correct point in the programme on return to automatic control. Protection commands shall have priority over manual commands, and manual commands shall prevail over auto commands.

5 Open or close priority shall be selectable for each drive.

6 The sequence startup mode shall be of the following types.

A Automatic Mode

B Semi-Automatic Mode

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | C Operator Guide Mode / Test Mode |
| 5.03.07 | For the drives, the command shall be provided through redundant O/P module to MCC/SWGR/Actuator as applicable and inputs (status, SWGR & process) shall be acquired through input modules. The failure of one of the redundant output module shall in no way affect the function of the other output module. |
| 5.03.08 | The output modules control module shall have the feature that ensures that in case of failure, all the outputs are driven to zero. The 24V DC command outputs to drives for ON/OPEN, OFF/CLOSE shall be separate and independent and inverted outputs shall not be employed. Keeping +24 V DC extended to the relays for these outputs continuously and extending ground/ negative when command is to be issued is not acceptable except some of the auxiliary plants as to be decided during detailed engineering. |
| 5.03.09 | For inching type of drives, position transmitter power supply and monitoring of position transmitter signal shall be provided. |
| 5.03.10 | The termination for OPEN (ON)/CLOSE (OFF) command for the drive actuator shall be performed in the actuators specified elsewhere in the specification. However, OPEN (ON)/CLOSE (OFF) and disturbance status as a minimum shall be monitored in OLCS. |
| 5.03.11 | The sequence interlock & protection requirements shall be finalized during detailed engineering and the same shall be subject to Employer's approval. |
| 5.03.12 | The drive function i.e. basic interlock & protection logic of the drive shall be implemented in redundant controllers. The drive function shall ensure that protection signals for the safety of the drive shall be effective under all conditions and under all modes of operation. The different commands shall be performed according to the priority of protection 'Off', Protection 'On', manual and automatic. The standard functions like running time monitoring, status signaling, alarm/drive annunciation, etc. shall be performed in drive function. The drive function shall prevent hunting of the actuator in the presence of both open & close commands for actuators of the valves & dampers. The drive function shall be implemented in dedicated standard software functional block. |
| 5.03.13 | The reversible drives to be controlled under OLCS shall be actuators with integral starters. These actuators will have coupling/interposing relays for accepting commands from OLCS and shall provide check back signals to OLCS. As such, all drive related inputs/outputs for reversible drives shall be available from actuators in field. The 'Open' and 'Closed' limit switches of each actuator shall be monitored with selectable delay time to check & alarm the contradictory condition of both contacts indicating 'Open' or 'Closed' status of actuators. The actuators for valves & dampers shall be interfaced as follows : |
| 5.03.14 | The open/close commands and check back signals from limit switches and disturbance signals shall be hardwired to respective OLCS group through I/O modules from actuators in the field. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
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| **5.04.00** | **Modulating Controls/Closed Loop Control System (CLCS) Functions** |
| 5.04.01 | This Clause is applicable for all analog controls of PLC. |
| 5.04.02 | The controller capability shall, as a minimum, include (i) P, PI, PD and PID control functions and their variations (ii) cascade control (iii) feed forward control (iv) On-Off control, (v) Ratio and bias control, (vi) Logical operation . |
| 5.04.03 | The loop reaction time (from change of output of the transmitter/temperature element to the corresponding control command output) shall be within 500 milli seconds. For binary control the response time shall be within 100 milli seconds only. |
| 5.04.04 | The control loop shall have enough flexibility and various features to perform feed forwards, balancing of controller, increasing the response to achieve the desired process parameter within prescribed time frame. |
| 5.04.05 | The control system shall be bumplessly transferred to manual on the conditions of Control power supply failure, Failure of redundant controllers, Field input signal not available, Analog input exceeding preset value, etc. as a minimum and as finalized during detailed engineering. |
| 5.04.06 | Any switch over from auto to manual, manual to auto and switchover from OWS operation to H/A station operation and vice versa shall be bump less and without resulting in any change in the plant regulations and the same shall be reported to the operator and recorded automatically. |
| 5.04.07 | The System being supplied shall be such that when permissible limits are exceeded, an automatic switchover from an operation governed by maximum efficiency, to an operation governed by safety and availability is affected. |
| 5.04.08 | For safety reasons, switchover logics associated with the modulating control loops shall be performed within the closed loop control equipment. Modulating control loops shall be provided with standard features to interface overriding commands from OLCS/Protection System like open, protection open etc. |
| 5.04.09 | All controllers shall be freely configurable with respect to requisite control algorithms. |
| **6.00.00** | **SYSTEM REACTION TIME** |
| 6.01.00 | The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions. |
| **7.00.00** | **OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS** |
| 7.01.00 | Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalised during detailed Engg. stage. |

7.02.00 Minimum quantities shall be as follows:-

1 Various displays on the OWS shall as a minimum include P&ID displays or mimic, bar chart displays, x-y & x-t plot (trend) displays, operator guidance message displays, group displays, plant start-up/shutdown message displays, system status displays etc. Number of displays and the exact functionality shall be on as required basis and as finalised during detailed engineering subject to the minimum quantities as given in subsequent clauses. For x-t & x-y plots, the facility of providing a background grid on operator request shall be variable with adequate no. Of divisions in both co-ordinates.

2 The Minimum Quantity of Major Types of Displays per unit shall be as follows:

| | | |
|---|---|---|
| a) | Control displays (group/sub-group/ sequence/loop) | (On as reqd. basis subject to 100 minimum) |
| b) | P&ID/ mimic display | 20 |
| C) | X-Y Plot (with superimposed operating curves + using user selectable stored data) | 25 + 25 |
| D) | Group displays | 20 |
| E) | Operator guidance message | 10 |
| F) | System status & other diagnostic display | on as required basis |

The assignment for the above will be done by the contractor as per the requirement of operation of contractor's system as well as for maintenance. The balance displays shall be left as spare for future modification/addition.

**8.00.00 HISTORICAL STORAGE AND RETRIEVAL SYSTEM (HSRS)**

8.00.01 The HSRS shall collect, store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 24 hours periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data .

8.00.02 The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports . The data/information to be stored & frequency of storage and retrieval shall be as finalised during detailed engineering. The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS or printer in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same. The logs/reports for at least last seven (7) days shall be available on the disk.

8.00.03 In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable long term storage media). These data will include any data from the database as well as processed/computed data based an various calculations/transformation. The retrieved data from long term storage media should be possible to be presented in form of alarms, logs, reports, etc.

**9.00.00 CONTROL & POWER SUPPLY SCHEME**

9.00.01 **General Requirements**

The requirements of Electrical Power Supply system are specified herein on system basis. The Contractor shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification including tender drawings and Employer approved drawings during detailed engineering. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipments and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures, & distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works.

The Contractor shall furnish all required equipment cubicles and wiring required for conversion and/or stabilization of the power sources provided by the Employer to all other levels which may be necessary for meeting the individual requirement of equipment/system furnished by him including the panel/desk mounted equipment.

24 V DC power supply system shall be provided as below:-

**i)** 24V DC power supply system for PLC based control system shall comprise of two sets, each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller – one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | Necessary redundant transformers shall be provided by the contractor to derive the power supply from 415V, 3 phase, 3 wire incomers for above. |
| 9.01.00 | **POWER SUPPLY SYSTEM FOR PLC BASED CONTROL PANELS** |
| 9.01.01 | Microprocessor based, Intelligent, Modular Power Supply. |
| 9.01.02 | Microprocessor based, intelligent, modular power supply shall be sized to meet connected load requirements and keep the connected battery full charged in Float/ Boost mode. A provision of 10% design margin shall be kept over and above the load requirement. Either of the bank of rectifier modules shall be able to recharge fully discharged battery within 8 hours. It shall also be possible to discharge batteries periodically manually. Each rectifier bank shall have N+1 rectifier modules for all applications. The exact sizing of the rectifiers in one bank shall be as approved by Employer during detailed engineering. While selecting the components and finalizing the cooling arrangements, Bidder to note that these rectifier modules are required to operate at 30-40 % of the rated load for most of the time. While sizing, the temperature derating factor as applicable, is to be considered for arriving at the rating of the modules as per Bidder's manufacturing standard if the modules are rated for lower than the 50 deg. C ambient. For the rectifier bank, matching controller along with applicable software shall be provided to meet system requirements under all modes of operation." |
| 9.01.03 | The rectifier module shall be microprocessor controlled, IGBT/Power MOSFET based, high frequency with active load sharing, designed for single and parallel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage and DC load fluctuates, effective current limiting features, front access design, programmable temperature compensation feature for battery charging and filters on both input and output to minimize harmonics. The rectifier module output regulation shall be +/- 1% or better from no load to full load with an input power supply variation of +/- 10% in voltage and +/- 5% in frequency. In addition to indications / display on rectifier panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in PLC system. Further isolated 4-20 mA signals shall be provided for important parameters like rectifier bank voltage, rectifier bank current, battery voltage, battery current, DCDB Voltage, DCDB current etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. Necessary provision shall be done in PLC end also. |
| 9.01.04 | "Float / Boost" charge functions shall be provided with alarm / indications. |
| 9.01.05 | Each rectifier bank shall be rated for 100% load requirement and keep the connected battery full charged and one spare rectifier module. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
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| 9.01.06 | The rectifier module circuitry shall be of fail-safe design and failure of any component should not result in any rectifier bank output voltage to increase beyond acceptable limits of the C&I system being fed from it. |
| 9.01.07 | The rectifier module shall be current limited for circuit protection and protection of battery from overcharge. The current limit shall be continuously programmable. |
| 9.01.08 | The rectifier module shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energized. |
| 9.01.09 | The rectifier module shall be fed from 415 V AC, 50 HZ, 3 phase, 3 wire system. Bidder shall provide all required power cables & other accessories etc. from 415 V AC power supply system to his electrical power supply system. |
| 9.01.10 | The full load efficiency of rectifier module at nominal input and output shall be 90%. The ripple content shall be limited to +/- 0.5% of output voltage. |
| 9.01.11 | Bidder shall furnish the equipment complete in all respect along with rectifier module rating & voltage drop calculations, supporting curves / data etc. |
| 9.01.12 | The Controller shall be intelligent, microprocessor controlled for monitoring & control of rectifier modules with features viz. auto / manual battery discharge test, battery reserve time prediction, energy management, float / boost mode control etc. |
| 9.01.13 | All software as required for smooth operation and monitoring of rectifier modules in conjunction with controller & BHMS shall be provided by the Contractor. |
| 9.02.00 | **Batteries for PLC system** |
| 9.02.01 | The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop of 2V from battery room to DCDB and DCDB to load, while sizing the battery. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 9.03.00 | **DC DISTRIBUTION BOARD (DCDB)**<br><br>Redundant DC feeders (one from each DCDB) shall supply each of the connected panels. From DCDB / panel to driver/load feeder shall be in scope of Bidder. The exact design, rating & number of feeders of the each redundant DCDB shall be as finalized during detailed engineering and as approved by Employer. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each DCDB. |
| 9.04.00 | **Battery Health Monitoring System (BHMS)**<br><br>BHMS, wherever applicable, shall include microprocessor based hardware and software to monitor the condition of each battery cell of 24 V DC systems on-line. With BHMS it shall be possible to measure & analyze the minimum and maximum voltage values of each battery-cell so that any damage to battery shall be prevented by pro-active maintenance. BHMS shall communicate with the charger/PLC and provide alarms as finalized by Employer during detailed engineering. |
| **9.05.00** | The UPS Power Supply for various systems shall consist of one or more of the following configurations.<br><br>Bidder shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and data sheets etc. & this shall be finalized subject to employer's approval during detailed engineering.<br><br>**Configuration B :** UPS system shall consist of 1 x 100% charger and inverter, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories.<br><br>The specifications for this UPS configuration shall be as per Cl.No. 9.06.00 to 9.06.05 and specifications for Battery shall be as per Cl. No 9.06.06 for Ni-Cd type Batteries.<br><br>**Configuration C :** On line UPS with remote monitoring having a battery backup of 30 min. The batteries for UPS System shall be Sealed Maintenance Free type and shall be as per Control System Vendor's standards. |
| **9.06.00** | **UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM**<br><br>The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 deg c. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | The UPS system shall meet the following requirements as a minimum.<br><br>If UPS KVA rating is applicable at a lower ambient temperature than specified 50 deg.c, the bidder shall consider a derating factor of at least 1.5%/deg.c for arriving at the specified UPS capacity at 50 deg.c ambient. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The inverter shall have sufficient capability to clear fault in the maximum rated branch circuit, limited to 8 percent of finally selected ups capacity. |
| **9.06.01** | **Chargers** |
| **9.06.01.01** | The chargers shall be self regulating, solid state silicon controlled, full-wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimise harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. Furthermore the charger should be able to re-charge the fully discharged battery within 8 hours. The charger output regulation shall be ± 1% from no load to full load with an input power supply variation of ± 10% in voltage and ± 5% in frequency. In addition to indications/display on charger panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. |
| **9.06.01.02** | The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised. |
| 9.06.01.03 | The chargers shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. |
| 9.06.01.04 | The minimum full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to +/- 2 % of Charger output voltage. |
| 9.06.01.05 | The UPS battery shall have sufficient amp-hour capacity to supply the steady state KVA rating of the UPS specified for 60 minute, irrespective of the actual load on UPS. |
| 9.06.01.06 | The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit. |
| 9.06.01.07 | The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the other charger whose mains input power supply is |

healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice & continue to charge the D.C. battery at all load conditions. The Bidder should note that this situation should not in any way lead to the discharge of the D.C. Battery.

**9.06.02** **Static Inverters**

The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts. single phase ,50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. The steady state voltage regulation shall be +/-2% and transient voltage regulation (on application/removal of 100% load) shall be +/-20%. Time to recover from transient to normal voltage shall not be more than 50 mSec. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination shall be better than ± 0.5% (automatically controlled). The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The inverter efficiency shall be at least 85% on full load and 80% on 50% load. The synchronisation limit for maintenance of synchronisation between the inverter and stand by AC source shall be 48-52Hz, field adjustable in steps of 1 Hz.

**9.06.03** **Static Switch and Manual Bypass Switch**

The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from (i) faulty inverter to healthy inverter in case of failure of one of the two inverters and (ii) from faulty inverter to standby AC source in case of failure of both the inverters. The transfer time shall be ¼ cycle maximum in synchronous mode.

Manual bypass switch shall be employed for isolating the UPS during maintenance.

Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each inverter. Peak Capacity shall be 1000% of continuous rating for 5 cycles.

**9.06.04** **Step Down Transformer and Voltage Stabiliser**

One 415V three phase to 230V, single phase transformer along with associated voltage stablizer shall be furnished with each UPS system. The transformer and stablizer combination shall convert Employer furnished 415V ± 10% three phase plant auxiliary AC supply to 230 V ± 2%, single phase standby AC Power Supply source.

The transformer shall be of low impedance air-cooled type and its KVA rating and percentage impedance should be selected so that extremely fast fault clearance is achieved.

The overload capacity of the transformer and voltage stabilizer shall not be less than 300% for 200 millisecond duration. The voltage stabilizer shall employ servo-controlled circuitry and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the stabiliser shall be 95% or better.

The type and other details shall be subject to Employer's approval.

**9.06.05** **AC Distribution Board (ACDB)**

The details of the AC distribution board, i.e. exact, rating and number of feeders etc. of the 2x100% ACDB shall be designed to cater to the requirements of Contractors systems. 25% Spare feeders of each type and rating to be provided in each ACDB.

**9.06.06** The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop from battery room to ACDB and ACDB to load, while sizing the battery.

**10.00.00** **CONTROL CABINETS / PANELS / DESKS**

10.01.00 The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.

10.01.01 The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
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| 10.01.02 | The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering. |
| 10.01.03 | Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided. |
| 10.01.04 | Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades:<br><br>(a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalised during detailed engineering.<br><br>(b.) Interior:- Same as above. |
| 10.01.05 | Paint films which show sags, checks or other imperfections shall not be acceptable. |
| 10.01.05 | As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable. |
| 10.01.06 | Refer Subsection Basic Design Criteria, Part-B, Section-VI for grounding requirements. |
| 10.02.00 | The mimic shall be configured on the OWS/CRTs and it shall be possible to control, monitor and operate the plant from the same. |
| 10.03.00 | The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 10.04.00 | **CONTROL DESK** |
| 10.04.01 | Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. A 19 mm thick wooden top shall be provided on the desk to keep the TFT monitors at top and computers inside. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, mouse pads, monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal and vertical directions. PA system hand sets, telephone sets, very few PB stations and lamps shall be mounted on the control desk on mosaic grid structure and same shall be decided during detailed engineering. ASCII Keyboard shall be capable of being pulled out through a tray. |
| 10.04.02 | The cabling / wiring between OWS & CPU'S, power supply cables etc. shall be aesthetically routed and concealed from view. |
| 10.05.00 | **FURNITURE** |
| | Chairs – Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back. Chair pedestal shall be made of 5mm thick MS plate covered with poly-propylene cladding. Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon. The exact details shall be finalized & approved by Employer during detailed engineering. |
| **11.00.00** | **ANNUNCIATION SYSTEM** |
| 11.01.00 | Only OWS based alarm system shall be provided with audio alarm facility ( beep/tone generator). No facia annunciation is envisaged in the control room. Hooters are to be provided. |
| 11.02.00 | The system shall display history of alarms in chronological order on any of the OWS. The HMIS shall have the capability to store a minimum of 500 alarms each with paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalised during detailed engineering. The alarm display/report format shall be as approved by the Employer. |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 11.03.00 | Facility of audio annunciation shall be provided in OWS upon the occurrence OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation shall be provided. |
| 11.04.00 | At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels. |
| 11.05.00 | Alarm boxes shall be provided in each display to alert the operator about an alarm when he is viewing some other picture. No of alarm boxes shall be finalised during detailed engineering for each process area & each priority therein. |
| 11.06.00 | The annunciator sequence shall conform to ISA sequence ISA-2A. |
| **12.00.00** | **SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS** |
| 12.01.00 | All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalization for Employer's review and approval. |
| 12.02.00 | All The software listings including Source code for application software, All special - to-project data files etc. shall be submitted by the Contractor. |
| **13.00.00** | **SOFTWARE LICENCES** |
| | The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to upgradation/change of hardware/machine in Contractor's System at site. All licenses shall be valid for the continuous service life of the plant.<br><br>As a customer support, the Contractor shall periodically inform the designated officer of the Employer about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site. |

**14.00.00** **SPECIFICATIONS OF PC BASED OWS**

| | |
|---|---|
| CPU | Latest generation CPU |
| Main memory | 2 GB expandable to 4 GB |
| DVD R/W | 16 x Or higher |
| Hard disk | 160 GB SAS |
| Removable bulk storage drive | 500 GB (minimum) |
| Monitor | 20" Full Flat TFT Resolution with non interfaced refresh rate min 75 Hz. |
| Graphic Memory | 128 MB |
| Communication port | 2 serial plus, one parallel, 1 USB port, Dual 100 Mbps Ethernet. |
| Expansion slots | 3 |
| Other Features | 101 Keys Keyboard and Optical Mouse |
| Software | a) General MS Windows latest version, MSOffice, Microsoft Visual Studio, Adobe Acrobat, anti-virus McAfee or equivalent, etc.<br>b) Application software - to suit project specific requirement |

**15.00.00** **PRINTER**

15.01.00 A4 size color laser printer shall be provided as a part of the HMIS system as per Part-A. It shall print out all alarm/trip conditions and event changes in plant status along with date and time of occurrence.

16.00.00 **ANNUAL MAINTENANCE CONTRACT (AMC)**

16.01.00 The Bidder shall provide maintenance services of complete control System under a comprehensive Annual Maintenance Contract (AMC) for period of one year after Warranty period and thereafter AMC for only hardware support for next two years.

16.02.00 The AMC shall cover total maintenance of all hardware & software coming under the scope of control system and shall include free repair/replacement of all cards/ modules/ peripherals/ cables/ components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMC. Bidder to ensure that system expert is available at site within 48 hours

| | |
|---|---|
| | of problem reporting by NTPC, in case the solution to the problem is not provided within 24 hours of problem reporting. |
| 16.03.00 | Further, bidder may note that during the AMC he will be allowed to use Employer's mandatory spares and has to replenish the same within three months' time or before completion of AMC period whichever is earlier. However, if in the opinion of the Bidder, more spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same. |
| 16.04.00 | The Bidder shall prepare detailed list of faults corrected and parts, expendables utilised during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Bidder's personnel. |

# SUB-SECTION-III-C6

# TYPE TEST REQUIREMENTS

## TYPE TEST REQUIREMENTS

**1.00.00 TYPE TEST REQUIREMENTS**

1.01.00 General Requirements

1.01.01 The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard.

(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.

(b) For the rest, submission of type test results and certificate shall be acceptable provided.

i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.

ii. There has been no change in the components from the offered equipment & tested equipment.

iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening but not more than five (5) year back.

(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.

1.01.02 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.

1.01.03 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

1.01.04 For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.

1.01.05 The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.

**2.00.00 SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS**

2.01.00 The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems Analyzer instruments, various PLCs etc. shall be as indicated below:

i) Surge Protections for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted alongwith the proposal. As an alternative to above, suitable class of IEC-60255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.

ii) Dry Heat test as per IEC-68-2-2 or equivalent.

iii) Damp Heat test as per IEC-68-2-3 or equivalent.

iv) Vibration test as per IEC-68-2-6 or equivalent.

v) Electrostatic discharge tests as per IEC 61000-4-2 or equivalent.

vi) Radio frequency immunity test as per EN 50082-2 or equivalent.

vii) Electromagnetic immunity as per EN 61131-2 or equivalent.

Test listed at item no. v, vi, vii, above are applicable for front end cards only as defined under item (i) above.

## 3.00.00 TYPE TEST REQUIREMENT FOR C&I SYSTEMS

| Sl No | Item | Test requirement | Standard | Test to be specifically conducted | NTPC's approval req. On test certificate | Remarks |
|---|---|---|---|---|---|---|
| Col 1 | Col 2 | Col 3 | Col 4 | Col 5 | Col 6 | Col 7 |
| 1 | Elect. Metering instruments | As per standard (col 4) | IS-1248 | No | Yes | |
| 2 | Electronic transmitter | As per standard (col 4) | BS-6447 / IEC-60770 | No | Yes | |
| 3 | INSTRUMENTATION CABLES TWISTED & SHIELDED | | | No | Yes | |
| 4 | Pressure gauge | Degree of protection test | IS-2147 | No | No | |
| | | Temp interference test | IS -3624 | No | No | |
| 5 | Temperature gauge | Degree of protection test | IS-2147 | No | No | |
| 6 | Pressure & DP switch | Degree of protection test | IS-2147 | No | No | |
| | | As per standard ( col 4) | BS 6134 | No | No | |
| 7 | Level switch | Degree of protection test | IS-2147 | No | No | |
| 8 | Control valves | CV Test | ISA 75.02 | No | Yes | |
| 9 | Flow Nozzles & Orifice plate | Calibration | ASME PTC , BS 1042 | No | Yes | |
| 10 | PLCs | All tests as per IEC-1131 | IEC-601131 | No | Yes | |

| Sl No | Item | Test requirement | Standard | Test to be specifically conducted | NTPC's approval req. On test certificate | Remarks |
|---|---|---|---|---|---|---|
| Col 1 | Col 2 | Col 3 | Col 4 | Col 5 | Col 6 | Col 7 |
| 11 | Junction Box | Degree of protection test | IS-13947 | No | Yes | |
| 12 | Battery charger (Not required for inbuilt chargers) | Degree of protection test | IS-13947 | No | No | |
| | | Short circuit current capability | IEC-60146-2 | No | Yes | |
| | | Temp rise test without redundant fans | Approved procedure, IEC 60146-2 | No | Yes | |
| | | SWC test | Approved procedure | No | Yes | |
| | | Burn-in-test | Approved procedure | No | Yes | |
| | | Efficiency | IEC-60146-2, | No | Yes | |
| | | Audible Noise Test | IEC 60146-2 | No | Yes | |
| | | Fuse Clearing Capability | Approved procedure | No | Yes | |
| | | Relative harmonic content | Approved procedure | No | Yes | |

| Sl No | Item | Test requirement | Standard | Test to be specifically conducted | NTPC's approval req. On test certificate | Remarks |
|---|---|---|---|---|---|---|
| Col 1 | Col 2 | Col 3 | Col 4 | Col 5 | Col 6 | Col 7 |
| | | ESD immunity test | IEC-61000-4-2-9(1) | No | Yes | |
| | | Radio interference | IEC 60146-2 | No | Yes | |
| | | Over Load Test on Inverter & charger | Approved procedure | No | Yes | |
| | | Restart Test | IEC 60146-2 | No | Yes | |
| | | Output voltage tolerance | Approved | No | Yes | |
| | | Output voltage Harmonic content | Approved procedure | No | Yes | |
| | | Insulation test | IEC 60146 | No | Yes | |
| | | Load Tests | Approved procedure | No | Yes | |
| | | Preliminary light load test | IEC 60146 | No | Yes | |
| | | Current division / Voltage division | IEC 60146-2 | No | Yes | |
| 13 | Battery | As per standard (col 4) | IEC –623 / IS 10918 for Ni-Cd IS-1652 for Plante Lead Acid | No | Yes | |
| 14 | Voltage stabilizers | Over Load Test | Approved procedure | No | Yes | |

| Sl No | Item | Test requirement | Standard | Test to be specifically conducted | NTPC's approval req. On test certificate | Remarks |
|---|---|---|---|---|---|---|
| Col 1 | Col 2 | Col 3 | Col 4 | Col 5 | Col 6 | Col 7 |
| | | Temp rise test without redundant fans | Approved procedure | No | Yes | |

# SUB-SECTION-III-C7

# CONTROL VALVES, ACTUATORS & ACCESSORIES

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

## CONTROL VALVES, ACTUATORS & ACCESSORIES

**1.00.00 CONTROL VALVES & ACCESSORIES**

1.01.00 General Requirements

1.01.01 The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.

1.01.02 All the control valves and accessories offered by the Bidder, shall be from reputed, experienced manufacturers of specified type and range of valves.

**1.02.00 CONTROL VALVE SIZING & CONSTRUCTION**

1.02.01 The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.

1.02.02 The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering.

1.02.03 Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.

1.02.04 Control valves shall have leakage rate as per leakage Class-IV.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| 1.02.05 | The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers. |
| **2.00.00** | **VALVE CONSTRUCTION** |
| 2.01.00 | All valves shall be of globe /Butterfly body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit. |
| 2.02.00 | Valves with high lift cage guided plugs & quick-change trims shall be supplied. |
| 2.03.00 | Cast Iron valves are not acceptable. |
| 2.04.00 | Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable. |
| 2.05.00 | Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems. |
| 2.06.00 | All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing) |
| 2.07.00 | Valve characteristic shall match with the process characteristics. |
| 2.08.00 | Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C. |
| 2.09.00 | Flanged valves shall be rated at no less then ANSI press class of 300 lbs. |
| **3.00.00** | **VALVE MATERIALS** |
| | Refer mechanical sections for body and trim materials. The exact body and trim materials shall be finalised during detailed engineering depending on the service applications.<br><br>However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval. |

**4.00.00** **END PREPARATION**

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalised during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

**5.00.00** **VALVE ACTUATORS**

All Control Valves shall be furnished with Pneumatic Actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

**6.00.00** **CONTROL VALVE ACCESSORY DEVICES**

6.01.00 All pneumatic**ally** actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, Microprocessor based Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

**7.00.00** **SPECIFICATIONS FOR MICROPROCESSOR BASED POSITIONERS**

| | | | |
|---|---|---|---|
| 1 | Electrical | a) Input signal | 4-20 mA |
| | | b) Power Supply | Loop powered from the output card of control system. |
| | | c) Hart Protocol | Compatibility for remote calibration & diagnostics (Super-imposed Hart signal on input signal (4-20 mA) |
| | | d) Valve position sensing | Non contact type position sensing **with** 4-20 mA output signal |

| CLAUSE NO. | TECHNICAL REQUIREMENTS | |
|---|---|---|

| | | | |
|---|---|---|---|
| 2 | Environment | a) Operating Temp | (-)30 To 80 Deg. C |
| | | b) Humidity | 0-95 % |
| | | c) Protection Class | IP-65 Minimum |
| 4 | Test reports/ certificates | Factory Valve Signature Tests reports (Pr vs Valve travel and Travel vs I/P signal) are to be provided. | |
| | | Test certificates as per Manufacture Standard/Relevant Standard are To Be Submitted | |
| 5 | Configuration/ calibration | Remote calibration, Auto & Manual calibration shall be possible. Universal HART Calibrator to be provided. | |
| 6 | Operating | Operating Range | Full range & split range signal. |
| 7 | Modes | Valve Action | Direct & Reverse valve action(selectable) |
| | | Flow Characterization | Possible to fit valve characteristic curve - Linear & Equal Percentage. |
| 8. | Fail Safe/Fail Freeze | Fail safe/Fail freeze feature is to be provided. (In case, the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit). | |
| 9 | Pneumatic | Air capacity | Sufficient to handle the valves selected/ boosters to be supplied if required. |
| | | Air supply pressure | To suit air supply pressure/quality available. |
| | | Process connection | 1/4 inch NPT |
| 10 | Electrical Cable Entry | 1/2-NPT, side or bottom entry to avoid water ingress. | |
| 11 | Performance | Characteristic Deviation | <=0.5 % Of Span |

| | | | |
|---|---|---|---|
| | | Ambient Temp Effect | <=0.01 %/Deg C Or Better |
| 12 | EMC & CE Compliance | Required To International Standard Like EN/IEC. | En50081-2& En50082 Or Equivalent |
| 13 | Accessories | In-built operator panel | Display with push buttons for configuration and display on the Positioner itself (password protected/hardware lock). |
| | | Press gauge block | For supply & output pressure. |
| | | Mounting assembly | On as required basis. |

**8.00.00 TEST AND EXAMINATION**

All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

8.01.00 Non Destructive Test as per ANSI B-16.34.

8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.

8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above.

8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

8.05.00 **CV Test**: Refer **Cl.no 3.00.00 (8) Subsection IIIC-06 (Type test requirements)**

**9.00.00 CONTROL VALVE QUANTITIES**

Bidder shall furnish all the control valves under this package as finalised during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.

# NTPC Limited

(A Government of India Enterprise)

# LOT 1A PROJECTS

# PART – B
# (DETAILED TECHNICAL SPECIFICATION)

## SUB-SECTION-V-Q
## (QUALITY ASSURANCE)

## SECTON – VI

## TECHNICAL SPECIFICATION

## FOR

## FLUE GAS DESULPHURISATION (FGD)

## SYSTEM PACKAGE

**BIDDING DOCUMENT NO. : CS-0011-109(1A)-2**

# PART – B (DETAILED TECHNICAL SPECIFICATION)

# SUB-SECTION- V-Q (QUALITY ASSURANCE)

# (MECHANICAL)

# SUB-SECTION-V-QM1

# FLUE GAS DESULPHURISATION SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

## 1.00.0 FLUE GAS DESULPHURISATION SYSTEM

### 1.01.0 Mills:

1.01.01 Raw material for shaft, coupling, gears and pinions, top and bottom races and other rotating components shall be subjected to UT. MPI/LPI shall be carried out to check surface soundness.

1.01.02 Wear-resistant parts shall be UT/RT tested to check soundness after suitable heat treatment. Check for chemical composition, hardness and microstructure shall be carried out.

1.01.03 Butt welds in the tube/separator/body casing of the mill shall be tested by RT and MPI. All other welds in main tube/separator shall be tested by MPI/LPI for acceptance. The tube shall be statically balanced.

1.01.04 All gearboxes shall be run tested for adequate duration to check rise in oil temperature, noise level and vibration. Check for leak tightness of gear case also shall be performed.

### 1.02.0 Feeders:

1.02.01 Any welds in the casing/pulley fabrication shall be checked with MPI.

1.02.02 Routine tests shall be done as per relevant Indian Standards or equivalent International Standards.

1.02.03 All major items like plates for casing, head pulley, tail pulley, pulley shaft and major castings shall be procured with respective material test certificates.

1.02.04 Calibration check shall be carried out on all feeders.

### 1.03.0 Dampers:

1.03.01 All the dampers shall be subjected to operational test/checks.

1.03.02 Gas tight Dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness as per NTPC Tech Specification.

### 1.04.0 PIPING, VALVE AND SPECIALITIES:

1.04.01 All pipes and fittings shall be tested as per applicable code.

1.04.02 All valves shall be hydraulically/Air tested for body, seat and back-seat (if applicable) as per relevant standard.

1.04.03 NDT on valves shall be as per relevant standard.

1.04.04 Valves shall be offered for hydro test in unpainted conditions.

1.04.05 Functional checks of the valves for smooth opening and closing shall also be done.

**1.05.00 TANKS / VESSELS:**

**1.05.01 Atmospheric tanks:**

i) All welds joints shall be DP tested and complete tanks shall be water fill tested.
ii) All atmospheric storage tanks fabricated and erected at site shall be subjected to tests (Hydro, NDT and Vacuum) according to design code as applicable.
iii) Rubber lining shall be tested for hardness and spark test, as applicable.

**1.05.02 Pressure vessels:**

1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below:

   i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds.
   ii) 10% DPT on all finished butt welds.
   iii) 10% RT (covering all 'T'/cross joints) of butt welds.

2) Butt welds of dished ends shall be stress relieved and subjected to 100% RT.
3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

**1.06.0 HEAT EXCHANGER/HEATER:**

1.06.01 All material shall be tested for chemical and mechanical properties and NDT as per relevant standard.

1.06.02 NDT on welds and other checks shall be as per relevant code.

1.06.03 Air heaters shall be subjected to dimensional and clearance checks as per standard practice

1.06.04 Lub. oil system, drive system, soot blowing system etc. of Air heaters shall be checked suitably as per standard practice

**1.07.0 PUMPS:**

1.07.01 UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.

1.07.02 The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.

1.07.03 The pump rotating parts shall be subjected to static and dynamic balancing.

1.07.04 All pumps shall be tested at shop for capacity, head efficiency and brake horse power at rated speed as per relevant/applicable standard.

1.07.05 Noise and vibration shall be measured during the performance testing at shop.

**1.08.0 STRUCTURES , DUCTS, HOPPERS:**

1.08.01 All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.

1.08.02 Visual inspection of all welds shall be performed in accordance with AWSD1.1.

1.08.03 NDT requirements of structural steel welds shall be as under:

i) 100% RT/UT on butt-welds of plate thickness>= 32mm.
ii) For plates of 25mm<=thickness<32mm-10% RT and 100% MPI.
iii) For plates of thickness <25mm-10% MPI/LPI.

1.08.04 Edge for shop and field weld shall be examined by MPI for plate thickness >= 32mm.

**1.09.0 VACUUM BELT FILTER SYSTEM:**

1.09.01 Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.

1.09.02 UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.

1.09.03 All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.

1.09.04 Filter cloths and belts shall be tested for physical properties as per relevant standard

1.09.05 Hydro cyclones shall be checked by visual, dimensional etc.

**1.10.0 SPRAY NOZZLES:**

1.10.01 Spray nozzles shall be tested for physical properties

1.10.02 Spray nozzles also shall be subjected to performance test.

**1.11.0 AGITATORS:**

1.11.01 Rubber lining shall be tested for hardness and spark test

1.11.02 Impellers shall be tested for dimensional and balancing check

1.11.03 Gear Boxes shall be tested for run test as per standard practice

**1.12.0 FANS:**

1.12.01 Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining.

1.12.02 Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.

1.12.03 All rotating components and assemblies of fan shall be balanced dynamically

1.12.04 Performance test shall be carried out on fans as per Technical specification/ Relevant standard

1.12.05 Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard

**1.13.0 Thermal Insulation, Lagging & Cladding:**

(a) **Lightly resin bonded mineral wool:**

LRB mattresses/sections of Rockwool/ Glasswool shall conform to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in respective Sub-Section of Technical Requirements of Steam Generator & Auxiliaries.

(b) **Lagging & Cladding:**

All insulation shall be protected by means of an outer covering of Aluminium sheeting confirming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.

**1.14.0 OTHER CRITICAL EQUIPMENTS:**

1.14.01 Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.

# SUB-SECTION-V-QM2

# LIME & GYPSUM HANDLING

# Lime & Gypsum Handling

**1.01.00 Brakes and Clamps :**

1.01.01 Final testing of brakes shall include load, HV/IR & heat run tests.

**1.02.00 Monorails and Hoists**

1.02.01 All electric hoist shall be tested as per IS 3938 and chain pulley block shall be tested as per IS 3832.

**1.03.00 Hoppers & Liners**

1.03.01 Rack & Pinion Gates/Flap Gates/Rod Gates

a) MPI/DP test shall be conducted on rack and pinion / rod / weld joint

b) Functional checks on the gates shall be carried out along with respective actuator, if applicable.

**1.04.00 Storage Silo**

1.04.01 All material shall be tested for Chemical & Mechanical properties as per relevant standard. MPI/DP test on welding shall be carried out. Fit up assembly checks shall be carried out at shop for all despatchable segments

1.04.02 Bag Filters : Leakage test shall be carried out for pressure parts. Pulsing and sequential test on bag filter shall be done.

**1.05.00 Belt Conveyor System**

The details of the checks to be carried out in the various equipments are to be submitted by the Contractor for Owner's approval. However, some indicative checks on different items are given below which should necessarily form a part of the Quality Assurance Plan to be agreed with the Owner.

**1.05.01 Idlers**

a) Check for run out and free movement shall be carried out on idlers. Run out shall be restricted as per IS:8598

**b)** Test for dust proofness, water proofness and dynamic friction factor of the Idlers shall be conducted at shop. The detailed procedures for the same shall be submitted for review and approval.

**1.05.02 Belting**

(a) Rubber cover of finished belt shall be checked for tensile strength and elongation at break before and after ageing. Rubber cover shall also be checked for abrasion, tear strength and hardness.

(b) For finished belts, checks for elongation at 10% nominal tensile strength, tensile and elongation at break in longitudinal (warp) direction and tensile in transverse (weft) direction shall be carried out.

(c) Adhesion test between ply to ply and cover to ply shall be carried out.

(d) Troughability test and Test for fire resistance shall be carried out.

(e) Test for procedure qualification for belt vulcanizing joint (at site) shall be done. Procedure for belt vulcanizing joint shall be discussed and finalized during FQP finalization.

(f) There will be a limitation on the no. of repairs allowed on the belts. Following will be the acceptance norm for the cover repairs.

i) The maximum size of a repair shall be limited to a size equivalent to one fifth the belt width. No single dimension shall exceed one fifth(1/5) of belt width.

ii) Small local repair by dough filling of size 25mm x 25mm to a limited extent shall not be counted of repairs. However, in case of cluster of repairs, same shall be counted as a patch repair.

iii) The maximum number of patch repair shall not exceed 5 per 100 mts. However, the total number of patch and dough filling repairs shall not exceed 10 per 100 meters.

(g) In addition to above, Steel Cord belt shall also be tested for following.

i. Cord dia and breaking strength

ii. Finished belt shall be tested for cord pull-out strength before and after aeging, peeling resistance.

iii. Dynamic cord pull out test

iv. Cord dia, pitch and number of cords

(h) In no case shall the cover thickness or the width of belt be less than that given in specification.

(i) For testing purpose, belt sample shall be taken from anywhere of the belt roll length offered

**1.05.03 Belt Vulcanizing Machine**

a) Check for tensile strength shall be carried out on a sample vulcanized belt joint for each type of belt in shop. However if such test has been done earlier, the report for same shall be submitted for verification.

b) Complete assembly shall be tested at shop for temp. and pressure developed

**1.05.04 Pulleys**

a) In addition to chemical, mechanical, hardness, microstructure as per applicable material specification, pulleys shaft forgings shall be subjected to ultrasonic testing.

b) 100% MPI/DPT on all welds shall be conducted and 10% RT/UT on butt welds shall be conducted.

c) Static balancing of pulleys shall be carried out after rubber lagging.

d) Checks on rubber lagging to include abrasion loss, shore hardness test, peel-off strength test and physical properties. Peel-off strength shall be 10 Kg/Cm, Abrasion loss shall be less than 250 cubic mm when tested as per DIN 53516.

**1.05.05 Pull Chord & Belt Sway Switches**

a. Acceptance tests

i) Over all dimension and functional test.

ii) HV & IR test

iii) Degree of protection test report.

**1.05.06 Zero Speed Switch, Under Belt Switch and Chute Blockage Switch**

a Acceptance test

i) Burn in test at 50 degree C for 48 hours shall be done for electronic switches.

ii) Over all dimension and functional test shall be carried out.

iii) HV & IR

iv) Degree of protection test

**1.06.00 Drive Equipments**

**1.06.01 Gear Boxes :**

(a) In addition to checks for physical, chemical, hardness,microstructure as per relevant standard, the shaft and gear/pinion forgings shall be subjected to ultrasonic testing .

(b) MPI to be carried out on Gears/Pinions after machining. Case depth, hardness and MPI after hardfacing shall be checked to ensure freedom from defects.

(c) Gear reducer shall be checked for reduction ratio, backlash and contact pattern. No load shop trial run to be conducted on gear boxes to check for oil leakage, temperature rise, noise level and vibration .

**1.06.02 Flexible Coupling**

(a) Ultrasonic testing shall be conducted on forgings for gear sleeve and gear hub, if gear coupling is provided.

(b) MPI shall be carried out after machining to ensure freedom from cracks.

**1.06.03 Fluid Coupling**

(a) Dynamic balancing shall be carried out for the rotating parts.

(b) Check for leak tightness of the coupling shall be carried out.

(c) Functional test on fusible plug for each type of coupling shall be conducted at shop.

(d) All couplings to be run tested at shop on no load

(e) Check for temperature rise, torque-speed, torque-slip characteristics and over speed test shall be included during performance test of one coupling of each type preferably at full load.

**1.07.00 Belt Scales**

The details of the checks to be carried out in the various equipments are to be submitted by the Contractor for Employer's approval. However, some indicative checks are given below which should necessarily form a part of the quality assurance plan to be agreed with the Employer.

1.07.01 Mounting arrangement/Overall dimensional check shall be carried out on the Belt Scales.

1.07.02 Belt scale shall be calibrated with test weight/test chain in static at works and with test weight for dynamic condition at site.

1.07.03 All electronic modules shall be subjected to burn in test at 50 Degree C for 48 hours.

1.07.04 General check for load cell shall be carried out.

1.07.05 Test report for degree of protection on enclosure shall be furnished.

1.07.06 Accuracy/performance check shall be demonstrated at site.

**1.08.00 Dust Control & Miscellaneous Systems(Dust Suppression & Dry Fog Dust Suppression System)**

The details of the checks to be carried out on the various equipments are to be submitted by the Contractor for Owners approval. However some indicative checks on different items are given below which should necessarily form a part of the Quality Assurance Plan to be agreed with by the Owner.

**1.08.01 Pumps**

(a) All materials should be of tested quality and test certificates to be provided.

(b) DPT of machined shaft and impeller shall be done.

(c) Shaft forgings to be also subjected to ultrasonic testing.

(d) Impellers to be dynamically balanced to ISO 1940 Gr.6.3

(e) All pressure parts shall be hydraulically tested at 150% of the shut-off head or 200% of rated head, whichever is higher for 30 minutes. No leakage is allowed.

(f) All pumps to be performance tested as per Hydraulic Institute Standard/Indian Standard. Performance test to include check for noise, vibration level and temperature rise.

**1.08.02 Valves & Specialities**

(a) Valves and Specialities shall be tested as per relevant standards / codes.

(b) Seat Leakage and hydraulic test to be carried out as per relevant standards / codes.

**1.08.03 Pipes and Fittings**

Pipes and fittings shall be tested as per relevant standards/ codes

**1.08.04 Air Compressor**

a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure for a duration of 30 minutes prior to painting.

b) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes.

c) Ultrasonic testing shall be carried out on all forgings and rotor for dia 50mm and above. MPI/DPT shall be done on machined area of the components.

d) During assembly all clearances and alignments shall also be checked and recorded

e) Rotor shall be statically and dynamically balanced

f) Performance Test(Shop Test)

i. Performance test on the compressor shall be carried out in accordance with ISO:1217/Eq. The test shall also include demonstration of loading and unloading mechanism(Capacity control) and operation of safety valve

ii. Vibration and Noise level measurement shall be done during shop performance test.

**1.08.05 Air Receiver**

a) Each finished vessel shall be hydraulically tested at 150% of the design pressure for a duration of 30 minutes

b) NDT on weld joints shall be as per respective code requirements or the minimum as specified below

i. 100% DPT on root run of butt welds

ii. 100% DPT on all finished butt welds and fillet welds

iii. 10% RT on butt welds which shall include all T-Joints

**1.09.00 Dust Extraction and Ventilation System**

**1.09.01** Fan

(a) All materials should be of tested quality and test certificates should be provided.

(b) Dynamic balancing of the fan impellers to be carried out.

(c) Shop run test shall be conducted on all centrifugal fans including check for noise and vibration level.

(d) Performance test shall be conducted on one fan of each type at shop for capacity, pressure, efficiency and power consumption.

**1.09.02 Valves and Specialties**

Refer 1.08.02 above

**1.09.03 Pipes and Fittings**

Refer 1.08.03 above

**1.09.04 Package Air-Conditioner**

Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard. Performance test of PAC shall be carried out as per relevant standard on one unit of each type and rating at site.

**1.10.00 Crushers**

The details of the checks to be carried out for various components are to be submitted by the Contractor for Owner's approval. However, some indicative checks on different items are given below which should necessarily form part of the Quality Assurance Plan to be agreed with the Owner.

(a) All plates equal to or above 25mm thickness shall be ultrasonically tested.

(b) Shaft forgings and suspension bars to be checked for ultrasonic testing in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification.

(c) Following minimum NDT requirements to be ensured for welds:

i) Butt welds - 10% UT/RT and 100% MPI/DPT.

ii) Fillet Welds - 10% MPI/DPT.

(d) Crusher rotor to be dynamically balanced. Procedure to be submitted for approval.

(e) No-load trial run test to be carried out at shop to check for speed(RPM),temperature rise, noise level and vibration .

**1.11.00 Mobile Trippers**

(a) Shaft and wheel forgings – Ultrasonic test in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification shall be conducted.

(b) Following minimum NDT requirements to be ensured for welds:

i) Butt welds - 10% UT/RT and 100% MPI/DPT.

ii) Fillet Welds - 10% MPI/DPT.

(c) Shop trial run test shall be carried out and shall include check for noise level and vibration.

**1.12.00 In-Line Magnetic Separators**

i) Overall Dimensional, Visual check alongwith control panel.

ii) HV & IR.

iii) Operation, temperature rise, lifting capacity, force index and gauss strength.

**1.13.00 Metal Detectors**

i) Functional test including sensitivity, Burn in test, operation of liquid spray marker, detection of smallest piece of different materials as specified.

ii) Test report for Degree of protection test to be furnished.

**1.14.00 Sampling Units**

(a) Free carriage and cutter movement, speed of cutter and dust door closing and sealing shall be tested for samplers.

(b) “No load test” shall be carried out for crushers.

**1.15.00 Elevators (Passenger cum goods elevator)**

Refer QA table for passenger/service elevator.

## 1.16.00 Steel Structure

1.16.01 Only material which has been identified against mill sheet or test certificates shall be used for construction. Check testing shall be carried out in the absence of MTC. Correlation shall be maintained by Manufacturer. All plates above 40mm thickness shall be 100% ultrasonically tested.

1.16.02 Visual inspection of all welds shall be performed in accordance with AWS D.1.1.

1.16.03 NDT requirements of structural steel welds shall be as under:

a) 100% RT/UT on butt-welds of plate thickness >= 32 mm. Edge for field weld shall be examined by MPI for plate thickness >= 32mm.

b) For Plates of 10 mm < thickness < 32 mm - 10% RT On butt welds.

c) 10% Ultrasonic testing shall be carried out on full penetration welds (other than butt welds)

d) DP Test on Welds:

- 100% on Root Run & 10% on Final Welds of all butt welds
- At random 5% on fillet of built-up plate girders.

1.16.04 Girders/columns/Beams etc shall be trial assembled and match marked prior to dispatch. Trial assembly procedure at shop shall be submitted for NTPC review and approval.

1.17.00 **Paddle feeder**

1.17.01 Shaft and wheel forgings – Chemical, Mechanical, Hardness and Ultrasonic Test shall be conducted.

1.17.02 Following minimum NDT on Weld Joint shall be carried out

(a) Butt Welds - 10% UT/RT & 100% MPI/DPT

(b) Fillet Welds - 10% MPI/DPT

1.17.03 Shop trial run shall be conducted to check for movement and RPM of Paddle wheel & Travel wheel, function of P/F in locked rotor condition, noise and vibration etc.

1.18.00 **Vibrating Screen Feeders**

(a) Shaft forgings to be checked for ultrasonic testing in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification

(b) Following minimum NDT requirements to be ensured for welds:

i) Butt welds - 10% UT/RT and 100% MPI/DPT.

ii) Fillet Welds - 10% MPI/DPT.

(c) Shop trial run test shall be conducted to checks for speed (RPM), amplitude (stroke), temperature rise and noise level.

**1.19.00 APRON FEEDER**

1.19.01 All plates equal to or above 25 mm thickness shall be ultrasonically tested.

1.19.02 Castings and forgings, forged/rolled bar/section shall be subjected to ultrasonically test in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification.

1.19.03 Machined and hard faced surface of casting/forging and other hardened, stellited parts shall be subjected to DPT/MPI in addition to check for case depth, hardness as applicable for chain/sprocket/gear reducer/rollers/wheel/pan etc.

1.19.04 Suitable check for life time sealing of rollers for protection from dust and water shall be done

1.19.05 Following minimum NDT requirements shall be followed for welds:

i) Butt Welds in Tension- 100% UT/RT and 100% MPI/DPT.

ii) Butt Welds in Compression- 10% UT/RT and 10% MPI/DPT.

iii) Fillet Welds - 10% MPI/DPT.

1.19.06 For other items like drive system, motor, pulley, belt relevant portion of specification shall be applicable

1.19.07 No load trial run test shall be carried out at shop on completely assembled apron feeder to check for trouble free operation, temperature rise, Noise & vibration.

# SUB-SECTION-V-QM3

# EQUIPMENT COOLING WATER SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

**CLAUSE NO.**

## QUALITY ASSURANCE

## EQUIPMENT COOLING WATER SYSTEM

| | TEST / CHECKS / ITEM / COMPONENTS | Material Test | WPS/PQR/Welder Qualification | DPT/MPI | Assembly Fit Up | Visual & Dimensional Check | UT | RT | Hydraulic / Water Fill | Balancing | Type Test | Performance Test | Other Test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A** | **PLATE TYPE HEAT EXCHANGER** | | Y | Y[3] | Y | Y | | | Y | | | | |
| A.1 | Heat Transfer Plates | Y[1] | | Y[2] | | Y | | | | | | | Y[7] |
| A.2 | Gaskets | Y | | | | Y | | | | | | | |
| A.3 | Cover Plates (Front & Rear) | Y[1] | | | | Y | Y[5] | | | | | | |
| A.4 | Tie Rods | Y[1] | | Y[4] | | | Y[6] | | | | | | |
| **B** | **HORIZONTAL CENTRIFUGAL PUMP** | | | | Y | Y | | | | | | Y[10] | |
| B.1 | Casing | Y[1] | | Y[4] | | Y | | | Y8 | | | | |
| B.2 | Impeller | Y[1] | | Y[4] | | Y | | | | Y[9] | | | |
| B.3 | Shaft | Y[1] | | Y | | Y | Y[6] | | | Y[9] | | | |

**NOTES**

1 One per heat / HT batch

2 DP Test shall be conducted for 10% of the lot of HT plates. However, in case of any defect, entire lot shall be tested and only defect free plates shall be accepted.

3 100% DP Test shall be conducted on butt welds and 10% DPT on fillet weld after final run.

4 100% DPT shall be carried out on machined surfaces.

5 UT shall be done on plates with thickness 25 mm or above.

6 UT shall be done on shaft / tie rod with diameter above 40 mm.

7 After pressing each HT plate shall be subjected to either of the following tests, as per Manufacturer Practice
a) Light Box Test b) Vacuum Test c) Air Chamber Test

8 All pressure retaining parts shall be hydrostatically tested at 200% of pump rated head or 150% of shut – off head, whichever is higher, for at least 30 minutes. No leakage is allowed.

9 Static and Dynamic Balancing shall be carried out on complete rotor assembly.

10 All pumps shall be tested at rated speed, for head, flow capacity, efficiency and power consumption for the entire operating range i.e. from shut off head to maximum flow. A minimum of 7 readings shall be taken to plot the curve, with one reading at design flow. Testing standard shall be HIS (Hydraulic Institute Standard) of USA.
Performance test shall be carried out with contract motor, wherever Liquidated Damages are to be ascertained based on performance test at shop.

11 For Pipes, Valves and RE Joints refer LP Piping System requirements.

# SUB-SECTION-V-QM4

# AIR CONDITIONING & VENTILATION SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

## AIR CONDITIONING AND VENTILATION SYSTEM FOR FGDS

| CLAUSE NO | QA MODULE FOR AIR CONDITIONING AND VENTILATION SYSTEM |
|---|---|
| 1.00.00 | Air cooled Condensing Unit (Outdoor unit), Evaporating unit (Indoor unit) |
| 1.01.00 | Compressor of Condensing Unit shall be tested as per relevant standard |
| 1.01.01 | Condenser (Heat Exchanger) , Evaporator coils assembly shall be subjected to Hydraulic/Pneumatic pressure/leakage test as applicable and Electronic refrigerant leakage test along with all relevant test on tube as per applicable code.. |
| 1.01.02 | Assembled Condensing unit (Outdoor Unit) shall be subjected to Leakage test,Vacuum test, Run test/Functional test as applicable |
| | |
| 2.00.00 | **FANS** |
| 2.01.00 | 20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out. |
| 2.02.00 | DPT of fan shafts shall be carried out after machining. |
| 2.03.00 | UT of fan shafts (diameter equal to or above 50mm) shall be carried out. |
| 2.04.00 | Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3 |
| 2.05.00 | All Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test. |
| 2.06.00 | One fan of each type and size will be performance tested as per corresponding BIS /AMCA for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise. |
| | |
| 3.00.00 | **AIR HANDLING UNIT** |
| 3.01.00 | For Fans refer tests as mentioned at 2.00.00 |
| 3.02.00 | One per type of assembled AHU (AHU casing and fan assembly) shall be subjected to free run test. Noise, Vibration and Temp. Rise of bearing shall be measured during run test. |
| 3.03.00 | All cooling coil shall be pneumatically tested and no leakage shall be permitted. |
| | |
| 4.00.00 | **CENTRIFUGAL PUMP** |
| 4.01.00 | UT on pump shaft (dia equal to or above 40 mm) and MPI/DPT on pump shaft and impeller after machining shall be carried out. |
| 4.02.00 | All rotating components of the pumps shall be dynamically balanced to ISO-1940 Gr. 6.3 |
| 4.03.00 | A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the shut off pressure on the head characteristics curve or twice the rated pressure whichever is higher, for a minimum duration of 30 minutes. |
| 4.04.00 | Standard Running Test |

| | |
|---|---|
| 4.05.01 | All pumps shall be tested in the manufacturer's works preferably with contract motor for capacity, efficiency, head and brake horse power. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. The duration of test shall be minimum one (1) hr. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and/or as per applicable Indian Standard or equivalent. Acceptance norms shall be as per approved datasheet & HIS standard only. |
| 4.05.02 | Noise and vibration shall be measured at shop for reference purpose only. |
| 4.05.03 | Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and/or excessive vibration are observed during the shop test. |
| 4.05.04 | NPSH test shall be conducted with water as the medium, if required as per approved data sheets. |
| | |
| 5.00.00 | **LOW PRESSURE AIR DISTRIBUTION SYSTEM** |
| 5.01.00 | Functional test for fire damper along with solenoid shall be done. |
| 5.02.00 | Prototype tests report of fire damper (duly approved/accepted by ENGG) for each type and size as per UL-555 for fire rating shall be furnished. |
| 5.03.00 | Site Test- After completion, all ducting system shall be checked/tested for air leakages/tightness (smoke test) at site. |
| | |
| 6.00.00 | **INSULATION** |
| 6.01.00 | Insulation material shall be tested for all mandatory tests only as per relevant code/standard. |
| 6.02.00 | Thermal conductivity tests (for thermal insulation only) shall be done as per relevant code for the same density and thickness of material and validity of test shall be as per relevant standard. |
| | |
| 7.00.00 | **AIR FILTERS** |
| 7.01.00 | Pre/Fine filters shall be tested for initial and final pressure drop Vs flow and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779.<br>HEPA (Absolute) filters shall be tested as per applicable code. |
| 8.00.00 | **PIPES & FITTINGS** |
| 8.01.00 | All pipes and fittings shall be tested as per applicable codes / standard. |
| 8.02.00 | Site test- Pipes shall be tested at site hydraulically/pneumatically as per application requirement |
| 9.00.00 | **VALVES & SPECIALTIES** |
| 9.01.00 | Visual and dimensional check of valves as per relevant codes and approved drawing. |
| 9.02.00 | All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure. |

| | |
|---|---|
| 9.03.00 | Valves shall be offered for hydro test and pneumatic test in unpainted condition. |
| 9.04.00 | Functional check of the valves for smooth opening and closing shall be done. |
| 10.00.00 | **SPLIT/CASSETTE / WINDOW AC/ PAC** |
| 10.01.00 | Split/Cassette/ Window AC will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate. |
| 10.02.00 | PAC Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard. |
| 10.03.00 | Performance test of PAC shall be carried out as per relevant standard on one unit of each type and rating at site. |
| 11.00.00 | **Unitary Air Filter (UAF)** |
| 11.01.00 | Random 10% DPT on weld joints shall be carried out |
| 11.02.00 | Hydraulic test of pressure parts at 1.5 times the design. Pressure and water fill test of tanks shall be carried out |
| 11.03.00 | Trial assembly of Air washer/UAF for one of each size shall be done in shop. |

# SUB-SECTION-V-QM5

# ZERO LIQUID DISCHARGE SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

## ZERO LIQUID DISCHARGE (ZLD) PLANT FOR FGD WASTE WATER

| Items / Components \ Test/Check | Material Test | WPS/PQR/Welder | DPT/MPI | Assembly Fit up | Dimension | RT | Hydraulic test / Pneumatic test / Vacuum test | Performance Test | Test as per relevant Std / Appd. Data Sheets | Other Tests | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **COMMON ITEMS:** | | | | | | | | | | | |
| **1. Horizontal Centrifugal Pumps** | | | | Y | Y | | | $Y^1$ | Y | | |
| 1.1. Casing | $Y^a$ | | $Y^b$ | | Y | | Y | | | | |
| 1.2. Impeller | $Y^a$ | | $Y^b$ | | Y | | | | | $Y^d$ | |
| 1.3. Shaft | $Y^a$ | | Y | | Y | | | | | $Y^c$ | |
| **2. Vertical Pumps** | | | | Y | Y | | | $Y^1$ | Y | | |
| 2.1. Casing | $Y^a$ | | $Y^b$ | | Y | | Y | | | | |
| 2.2. Impeller | $Y^a$ | | $Y^b$ | | Y | | | | | $Y^d$ | |
| 2.3. Shaft | $Y^a$ | | Y | | Y | | | | | $Y^c$ | |
| 2.4. Fabricated Parts | $Y^a$ | Y | $Y^b$ | | Y | $Y^2$ | Y | | | | |
| **3. Dosing/ Metering Pumps** | $Y^a$ | | | | Y | | Y | $Y^1$ | Y | | |
| **4. Gate/ Globe/ Check Valves** | $Y^a$ | | $Y^b$ | | Y | | Y | Y | Y | $Y^3, Y^6$ | |
| **5. Dual Plate Check Valves** | $Y^a$ | | $Y^b$ | | Y | | Y | Y | Y | $Y^6, Y^{12}$ | |
| **6. Diaphragm Valves** | $Y^a$ | | | | Y | | Y | | Y | $Y^4, Y^3$ | |
| **7. Butterfly Valves (Low Pr.)** | | | | Y | Y | | Y | Y | Y | $Y^3$ | |
| 7.1 Body & Disc (Cast | $Y^a$ | | $Y^b$ | | Y | | | | | | |
| 7.2 Body and Disc (Fabricated) | $Y^a$ | Y | $Y^b$ | | Y | | | | Y | $Y^2$ | |

**LEGENDS:** Applicable tests are identified by 'Y'.

$Y^a$ : One per Heat / Heat Treatment batch / Lot.

$Y^b$ : On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds.

$Y^c$ : UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 25 mm or above.

$Y^d$ :Dynamic Balancing per ISO: 1940, Grade 6.3 minimum shall be conducted for rotating assy.

$Y^1$ : As per Pump governing standard. Tolerences as per HIS, USA.

$Y^2$ : Random 10% RT to be conducted on butt welds for Thk $\geq$10 mm.

$Y^3$ : Seat Leakage Test for actuator operated valves shall be done by operating the valve with job actuator.

$Y^4$ : Tests on Rubber Diaphragms shall be conducted per batch of Rubber mix for Tensile, Elongation, Hardness, Thickness, Bleed Resistance. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted.

$Y^6$ : Blue Matching, Wear Travel for Gate Valves and reduced pressure test

## ZERO LIQUID DISCHARGE (ZLD) PLANT FOR FGD WASTE WATER

| Items / Components \ Test/Check | Material Test | WPS/PQR/Welder | DPT/MPI | Assembly Fit up | Dimension | RT | Hydraulic test / Pneumatic test / Vacuum test | Performance Test | Test as per relevant Std / Appd. Data Sheets | Other Tests | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.3 Shaft | Y[a] | | Y[b] | | Y | | | | | Y[c] | |
| **8. Plug/ Ball Valves (Low Pr.)** | Y[a] | | Y[b] | Y | Y | | Y | Y | Y | Y[3] | |
| **9. Blowers/ Compressors** | Y[a] | | Y[b] | Y | Y | | | Y | Y | Y[c], Y[d] | |
| **10. Tanks/ Pressure Vessels** | Y[a] | Y | Y[b] | Y | Y | Y[8] | Y | | Y | Y[7] | |
| **11. Rubber Lining** | Y[a] | | | | Y | | | | Y | Y[9] | |
| **12. Strainers** | Y[a] | Y | Y[b] | Y | Y | | Y | | Y | | |
| **13. Pipe & Pipe Fittings** | Y[a] | Y | Y | | Y | Y[8] | Y | | Y | | |
| **14. Agitators /Flash Mixer/ Flocculator** | Y[a] | Y | Y[b] | Y | Y | | | Y | | Y[10] | |
| **15. Ventilation/Exhaust Fan** | Y[a] | | Y[b] | Y | Y | | | Y[11] | Y | Y[c], Y[d] | |
| **16. Hoists & Cranes** | Y[a] | Y | Y[b] | Y | Y | Y[8] | | Y | Y | | |
| **17. Wrapping & Coatig Material** | Y | | | | Y | | | | Y | | |
| **18. Package/ Split AC** | Y | | | | | | | Y | Y | Y[14] | |
| **ZLD PLANT:** | | | | | | | | | | | |
| **1. Clariflocculator / Reactor Clarifier / Plate or Tube Settler** | Y[a] | Y | Y[b] | Y | Y | | | | Y | Y[10] | |
| **2. Chlorine Tonner / Chlorine Evaporator** | Y[a] | Y | Y[b] | Y | Y | Y[8] | Y | | Y | | |
| **3. Chlorinator / Ejector** | Y[a] | | | Y | Y | | Y | Y | Y | | |

for check valves shall be conducted as per relevant standards.

Y[7] : Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall also be stress relieved as per the requirement of code.

Y[8] : RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT.

Y[9] : Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted.

Y[10] :Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted.

Y[11] :One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured.

Y[12] :Dry cycle test on valve spring for 1, 00,000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring.

Y[14] : Electronic leak test for condenser & evaporator unit.

## ZERO LIQUID DISCHARGE (ZLD) PLANT FOR FGD WASTE WATER

| Items / Components \ Test/Check | Material Test | WPS/PQR/Welder | DPT/MPI | Assembly Fit up | Dimension | RT | Hydraulic test / Pneumatic test / Vacuum test | Performance Test | Test as per relevant Std / Appd. Data Sheets | Other Tests | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **4. Chlorine Gas Filter** | Y[a] | | | Y | Y | | Y | | Y | | Note:<br>The complete Piping system along with valves & fittings shall be hydraulically tested at 1.5 times design pressure or 2 times working pressure whichever is higher after erection at site. |
| **5. Heat Exchanger** | Y[a] | Y | Y[b] | Y | Y | | Y | | Y | | |
| **6. Centrifuge** | Y[a] | Y | Y[b] | Y | Y | | Y | Y | Y | | |
| **7. Filter Membrane** | | | | | Y | | | | Y | | |
| **8. RO Pressure tube** | Y[a] | | | | Y | | Y | | Y | | |
| **9. Pressure / Vacuum Relief valve / Pressure Regulating Valve** | Y[a] | | | Y | Y | | Y | Y | Y | | |

# SUB-SECTION-V-QM6

# COMPRESSOR AIR SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | QUALITY ASSURANCE |
|---|---|

**1.00.00** **AIR COMPRESSOR SYSTEM**

1.01.00 AIR COMPRESSORS :

a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining, if applicable. The test pressure will be maintained for 30 minutes.

b) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes.

c) Ultrasonic testing shall be carried out on all forgings and shafts (if dia.> 40mm). MPI/DP test will be done on machined areas of the above components.

e) During assembly all clearances and alignments shall also be checked and recorded.

f) Rotor shall be statically and dynamically balanced.

1.01.01 PERFORMANCE TEST (SHOP TEST) :

a) Performance test on the compressors shall be carried out in accordance relevant standard. The test shall also include demonstration of loading and unloading mechanism (Capacity control) and operation of safety valves.

b) Power consumption at motor input terminal at rated capacity as well as at fully unloaded condition of all the compressor shall be measured.

c) Vibration and noise level measurement will be done during shop performance test.

d) Test shall be carried out on all compressors with contract drive motor where power consumption for compressors has been indicated as a guaranteed parameter

e) Clearance on Type test requirements from Employer's Engg. Shall be reviewed prior to final clearance.

1.02.00 AIR RECEIVER, HEAT EXCHANGERS, MOISTURE SEPERATORS, AIR DRYING PLANT:

a) Each finished vessel shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

b) NDT on weld joints shall be as per respective code requirements or the minimum as specified below:

(i) 100 % DPT on root run of butt welds.

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|---|---|

(ii) 100% DPT on all finished butt welds and fillet welds

(iii) 10% RT on butt welds which shall include all T- joints.

c) Tube to Tube sheet joint of the heat exchangers shall be subject to Mock-up test as per the relevant standards.

d) Reactivation blowers shall be tested for FAD, temp. rise, noise & vibration. Rotating parts shall be dynamically balanced.

e) Completely assembled ADP shall be pneumatically tested at design pressure for a duration of 5 minutes. Functional and sequential operation testing of the completely assembled ADP shall be demonstrated at shop. Other accessories shall be tested as per relevant code and sections. Dew point measurement shall be done.

1.04.00 H.O.T. CRANE :

a) Chain pulley Blocks shall be tested as per IS: 3832.

b) Following NDT requirements shall be met :

(i) 100% RT of Butt welds in tension and 10% RT of butt welds in compression.

(ii) DP at random on all weldments.

Deflection, load, overload & travel check on HOT crane assembly shall be carried out as per IS:3177.

1.05.00 PIPINGS, VALVES, AND FITTINGS

a. All pipes and fittings shall be tested as per applicable code.

b. All valves shall be hydraulically tested for body, seat and back-seat (if applicable) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.

c. Valves shall be offered for hydro test in unpainted condition.

d. Functional checks of the valves for smooth opening and closing shall also be done.

All forgings, dia ≥ 40 mm shall be Ultrasonic Tested irrespective of the type, size & rating of the valve.

# SUB-SECTION-V-QM7

# FIRE DETECTION & PROTECTION SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | QUALITY ASSURANCE |
|---|---|
| **1.00.00** | **FIRE DETECTION & PROTECTION SYSTEM** |
| 1.01.00 | HYDRANT SYSTEM: Shop Tests |
| 1.01.01 | Hydrant Valve:<br>(a.) All valves shall be hydro tested for body and seat.<br>(b.) Capacity test / flow test shall be done as per relevant standard. |
| 1.01.02 | Water Monitor, Hoses, Branch Pipes, Couplings and Nozzles:<br>(a.) All tests including hydraulic test shall be done as per relevant Indian / International standard. |
| **1.02.00** | **HIGH / MEDIUM VELOCITY WATER SPRAY : Shop Tests** |
| 1.02.01 | For Pipes, Fittings, Valves and specialties, requirements are indicated separately. |
| 1.02.02 | Deluge Valves and Spray Nozzles<br>(a.) All valves shall be hydro tested for body and seat.<br>(b.) Performance test / functional test of 'Deluge Valves' and 'Spray Nozzles' shall be carried out. |
| 1.02.03 | **Detectors:** All 'Detectors' shall be tested as per relevant Indian / International Standards. Detectors shall also meet the requirements of UL / FM / LPC/VDS etc. |
| **1.03.00** | **PIPING, VALVE AND SPECIALITIES** |
| 1.03.01 | SHOP TESTS<br>(a.) All pipes and fittings shall be tested as per applicable code.<br>(b.) DPT of pipe welds (in case of rolled and welded pipes only) shall be carried out for root and finished welds.<br>(c.) All strainers shall be subjected to hydraulic pressure test for leakage and Pressure drop v/s Flow for each type and size.<br>(d.) All valves shall be hydraulically tested for body, seat and back seat (if applicable) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.<br>(e.) Valves shall be offered for hydro test in unpainted condition.<br>(f.) Functional checks of the valves for smooth opening and closing shall also be done. |

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|---|---|

(g.) Anti-corrosive protection shall be tested as per applicable code.

**1.04.00 PORTABLE & MOBILE FIRE EXTINGUISHERS**

1.04.01 SHOP TEST

(a.) All fire extinguishers shall be tested as per relevant standard.

(b.) Performance / function test shall be carried out on sampling basis as per relevant code / standard.

**1.05.00 SITE TESTS**:

(a.) Fire Extinguishers: A performance demonstration test at site of five (5) percent or one (1) number, whichever is higher, of each type and capacity of the extinguisher shall be carried out by the contractor. All consumables and replaceable items require for the contractor without any extra cost to employer would supply this test would be supplied by the Contractor without any extra cost to employer.

(b.) Piping Protection:

(1.) Thickness, Holiday by spark test, Adhesion test shall be carried out as per relevant standard.

(2.) Complete piping shall be Hydro pressure tested, at 1.5 X DP or 2 X MWP whichever is higher, before protection.

(c.) Welding of Pipes:

(1.) ERW Black / rolled welded:

100% DPT on root of butt and finish weld of butt and fillet.

RT on 10% randomly selected joints shall be carried out (for underground piping).

(2.) GI Pipes

Welding on GI Pipes in general shall not be done. Welding of GI Pipes, if permitted by design, (butt / socket / fillet weld) shall be done strictly as per approved drawing and procedure approved by NTPC Engineering. For all such welds 100% DP test and random 1% RT shall be done.

# (ELECTRICAL)

# SUB-SECTION-V-QE1

# MOTORS

# MOTOR

| TESTS/CHECKS / TEMS/COMPONENTS | Visual | Dimensional | Make/Type/Rating /General Physical Inspection | Mech/Chem. Properties | NDT /DP/MPI/UT | Metallography | Electrical Characteristics | Welding/Brazing(WPS/PQR) | Heat Treatment | Magnetic Characteristics | Hydraulic/Leak/Pressure Test | Thermal Characteristics | Run out | Dynamic Balancing | Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-I/ IS-12615 | Vibration | Over speed | Tan delta, shaft voltage & polarization index test | Paint shade, thickness & adhesion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plates for stator frame, end shield, spider etc. | Y | Y | Y | Y | Y | | | | Y | | | | | | | | | | |
| Shaft | Y | Y | Y | Y | Y | Y | | | Y | | | | | | | | | | |
| Magnetic Material | Y | Y | Y | Y | | | Y | | | Y | | Y | | | | | | | |
| Rotor Copper/Aluminium | Y | Y | Y | Y | | | Y | | Y | | | | | | | | | | |
| Stator copper | Y | Y | Y | Y | | | Y | | Y | | | Y | | | | | | | |
| SC Ring | Y | Y | Y | Y | Y | | Y | Y | Y | | | | | | | | | | |
| Insulating Material | Y | | Y | Y | | | Y | | | | | Y | | | | | | | |
| Tubes, for Cooler | Y | Y | Y | Y | Y | | | | Y | | Y | | | | | | | | |
| Sleeve Bearing | Y | Y | Y | Y | Y | | | | Y | | Y | | | | | | | | |
| Stator/Rotor, Exciter Coils | Y | Y | Y | | | | Y | Y | | | | | | | | | | | |
| Castings, stator frame, terminal box and bearing housing etc. | Y | Y | Y | Y | Y | | | Y | | | | | | | | | | | |
| Fabrication & machining of stator, rotor, terminal box | Y | Y | | | Y | | | Y | Y | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wound stator | Y | Y | | | | | Y | Y | | | | | | | | | | | |
| Wound Exciter | Y | Y | | | | | Y | Y | | | | | | | | | | | |
| Rotor complete | Y | Y | | | | | Y | | | | | | Y | Y | | | | | |
| Exciter, Stator, Rotor, Terminal Box assembly | Y | Y | | | | | Y | | | | | | | | | | | | |
| Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc. | Y | Y | Y | | | | | | | | | | | | | | | | |
| Complete Motor | Y | Y | Y | | | | | | | | | | | | Y | Y | Y | Y1 | Y |

**Note**: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant
supporting documents during QP finalization. However, No QP for LT motor upto 50KW.
2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard
3. Makes of major bought out items for HT motors will be subject to NTPC approval.
4. Y1 = for HT Motor / Machines only.

# SUB-SECTION-V-QE2

# MEDIUM VOLTAGE BUS DUCTS

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

SQE-06

## Medium Voltage BUS DUCT

| Items/Components Sub Systems / Attributes / Characteristics | Visual & Dimensional Checks | Electrical / Mechanical / Chemical Properties | WPS & PQR | NDT (RT / DP / MPI / UT) | Painting Quality & Adhesion Test | Galvanising Test as per IS: 2629 / 2633 / 6745 | Electrical clearance & Creepage distance | Functional/Operational check | Make / Type Rating / Model / TC / Embossing/Printing of make & batch /General Physical Inspection | Trial Assembly at works. | Routine Test as per relevant standard / NTPC Specification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Enclosure / Cubicle | Y | Y | | Y | Y | | Y | | | | Y |
| Bus bar Conductor / Flexible Connector & Dis-connector Link | Y | Y | | Y | | | | | | | |
| Galvanised Steel Structure & Plate (Steel as per IS:2062) | Y | | | | | Y | | | | | |
| Epoxy / Seal-off Bushing & Epoxy / Porcelain Post / Support Insulator | Y | Y | | | | | Y | | Y | | Y |
| Welding of enclosure & conductor | Y | | Y | Y | | | | | | | |
| Gasket, Silica gel Breather, Elastomer Spring Head | | Y | | | | | | Y | Y | | |
| Complete Bus Duct & Cubicles IS:8084 | Y | | | | Y | | Y | | | Y | Y |

Note:

1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2) All major Bought Out Items will be subject to NTPC approval.

# SUB-SECTION-V-QE3

# LT POWER CABLES

## LT Power Cables

| Attributes / Characteristics / Item / Components / Sub System Assembly | Make, Type & T.C as per relevant standard | Dimension/surface finish | Mechanical properties | Chemical Composition | Spark Test(as applicable) | Electrical properties | Hot Set Test/ Eccentricity & Ovality | Lay length & Sequence | Armour coverage, cross over, looseness, gap between two | Sequential marking/ Batch marking/ surface finish/ cable length | T.S & elongation before & after ageing on outer sheath & insulation | Thermal stability | Anti termite coating on wooden | Constructional requirements feature as per NTPC specification | Routine & Acceptance Tests as per relevant standard & NTPC specification | FRLS Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum (IS-8130) | Y | Y | Y | Y | | Y | | | | | | | | | | |
| XLPE Compound (IS-7098) | Y | | Y | | | Y | Y | | | | Y | | | | | |
| PVC insulation Compound (IS: 5831) | Y | | Y | | | Y | | | | | Y | Y | | | | |
| FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810( Part 58), IEC-60754 Part-1) | Y | | Y | | | | | | | | Y | Y | | | | Y |
| Extrusion & curing /Manufacturing of Core ( PVC / XLPE) | | Y | | | Y | | Y | | | | | Y | | | | |
| Core Laying | | | | | | | | Y | | | | | | | | |
| Armour wire/strip | Y | Y | Y | | | | | | | | | | | | | |
| Inner sheath | Y | Y | | | | | | | | | | | | | | |
| Armouring | | Y | | | | | | | Y | | | | | | | |
| Outer Sheathing | | Y | | | | | | | | Y | | | | | | |
| **Power Cable (Finished)** (IS-5831, ASTM-D2843, IS10810( Part 58), IEC-60754 Part-1, IEC 60332 part III cat B) | | | | | | | | Y | Y | Y | Y | Y | | Y | Y | Y |
| Wooden drum(IS-10418) /Steel Drum | | Y | | | | | | | | | | | Y | Y | | |

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to NTPC approval.

| | | |
|---|---|---|
| **ROUTINE TESTS** | **Following routine tests shall be carried out on each drum of finished cables for all types (PVC / XLPE insulated) & sizes.** | |
| 1) | Conductor Resistance test | |
| 2) | High voltage test | |
| | | |
| **ACCEPTANCE TESTS** | **Following Acceptance tests shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in the offered lot.** | |
| **A) For Conductor (as per sampling plan mentioned in IS: 1554 / 7098)** | | |
| | 1) | Annealing test (Copper) |
| | 2) | Tensile Test ( Aluminum) |
| | 3) | Wrapping Test ( Aluminum) |
| | 4) | Resistance test |
| | | |
| **B) For Armour Wires / Formed Wires ( If applicable ) (as per sampling plan mentioned in IS: 1554 / 7098)** | | |
| | 1. | Measurement of Dimensions |
| | 2. | Tensile Tests |
| | 3. | Elongation Test |
| | 4. | Torsion Test For Round wires only |
| | 5. | Wrapping Test |
| | 6. | Resistance Test |
| | 7. | Mass of Zinc coating test For G S wires / Formed wires only |
| | 8. | Uniformity of Zinc coating For G S wires / Formed wires only |
| | 9. | Adhesion test For G S wires / Formed wires only |
| | 10. | Freedom from surface defects |
| | | |
| **C ) For PVC / XLPE insulation & PVC Sheath (as per sampling plan mentioned in IS: 1554 / 7098)** | | |
| | 1) | Test for thickness |
| | 2) | Tensile strength & Elongation before ageing (for tests after ageing see “D”) |
| | 3) | Hot set test (For XLPE insulation) |

| D) Ageing test: | | | | |
|---|---|---|---|---|
| | **Criteria** | **Condition** | **Test Requirements** | **Remarks** |
| **PVC insulation & outer sheath:** | Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). **Tensile & elongation testing shall preferably be done with a computerized machine.** The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/ - 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard). | All sizes which meet the criteria | The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130ºc+/- 2ºc for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS. | In case the size does not meet the requirement in accelerated ageing test **then all sizes (which had met the criteria) will be put on ageing test as per IS.** |
| | | Sizes which do not meet the criteria | Every size will be put on ageing test as per IS. | ---- |
| **XLPE insulation** | Samples as per relevant IS, from each size of cables in the offered lot,will be put on ageing test as per IS. | | | |

| **E) Following tests will be carried out on completed cables as per IS on each size of each type (PVC / XLPE insulated)** | | |
|---|---|---|
| | 1) | Insulation resistance test ( Volume resistivity method ) |
| | 2) | High voltage test |

| **F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)** | | |
|---|---|---|
| | 1) | Thermal stability test on PVC insulation and outer sheath |
| | 2) | Oxygen index test on outer sheath |

| | | |
|---|---|---|
| | 3) | Smoke density rating test on outer sheath |
| | 4) | Acid gas generation test on outer sheath |
| **G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cables as per following sampling plan:** | | |
| | | This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured PVC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched together, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall be covered.<br>For one particular type, cables with OD less than or equal to 30 mm shall be clubbed together in touching formation while cables with OD greater than 30 mm shall be clubbed together leaving a gap equal to OD of cable having least diameter. Cable OD shall be taken as nominal overall diameter as per NTPC approved datasheet. |
| **H) Following tests shall be carried on one length of each size of each type (PVC / XLPE insulated) of offered lot:** | | |
| | 1) | Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch )number marking on sheath |
| | 2) | Measurement of Eccentricity & Ovality |

# SUB-SECTION-V-QE4

# CONTROL CABLES

## Control Cables

| Item / Components / Sub System Assembly \ Attributes / Characteristics | Make, Type & T.C as per relevant standard | Dimension/surface finish | Mechanical properties | Chemical Composition | Spark Test(as applicable) | Electrical properties | Lay length & Sequence | Armour coverage, cross over, looseness, gap between two | Sequential marking/ Batch marking/ surface finish/ cable length | T.S & elongation before & after ageing on outer sheath & insulation | Thermal stability | Anti termite coating on wooden | Constructional requirements feature as per NTPC specification | Routine & Acceptance Tests as per relevant standard & NTPC specification | FRLS Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Copper (IS-8130) | Y | Y | Y | Y | | Y | | | | | | | | | |
| PVC insulation Compound (IS: 5831) | Y | | Y | | | Y | | | | Y | Y | | | | |
| FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810( Part 58), IEC-60754 Part-1) | Y | | Y | | | | | | | Y | Y | | | | Y |
| Extrusion & curing /Manufacturing of Core | | Y | | | Y | | | | | | Y | | | | |
| Core Laying | | | | | | | Y | | | | | | | | |
| Armour wire/strip | Y | Y | Y | | | | | | | | | | | | |
| Inner sheath | Y | Y | | | | | | | | | | | | | |
| Armouring | | Y | | | | | | Y | | | | | | | |
| Outer Sheathing | | Y | | | | | | | Y | | | | | | |
| **Finished Cable** (IS-5831, ASTM-D2843, IS10810( Part 58), IEC-60754 Part-1, IEC 60332 part III cat B) | | | | | | | Y | Y | Y | Y | Y | | Y | Y | Y |
| Wooden drum(IS-10418) /Steel Drum | | Y | | | | | | | | | | Y | Y | | |

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to NTPC approval.

| | | |
|---|---|---|
| **ROUTINE TESTS** | **Following routine tests shall be carried out on each drum of finished cables for all sizes.** | |
| 1) | Conductor Resistance test | |
| 2) | High voltage test | |
| | | |
| **ACCEPTANCE TESTS** | **Following Acceptance tests shall be carried out on each size of cables, in the offered lot.** | |
| **A) For Conductor (as per sampling plan mentioned in IS: 1554)** | | |
| | 1) | Annealing test (Copper) |
| | 2) | Resistance test |
| | | |
| **B) For Armour Wires / Formed Wires ( If applicable ) (as per sampling plan mentioned in IS: 1554)** | | |
| | 1. | Measurement of Dimensions |
| | 2. | Tensile Tests |
| | 3. | Elongation Test |
| | 4. | Torsion Test For Round wires only |
| | 5. | Wrapping Test |
| | 6. | Resistance Test |
| | 7. | Mass of Zinc coating test For G S wires / Formed wires only |
| | 8. | Uniformity of Zinc coating For G S wires / Formed wires only |
| | 9. | Adhesion test For G S wires / Formed wires only |
| | 10. | Freedom from surface defects |
| | | |
| **C) For PVC insulation & PVC Sheath (as per sampling plan mentioned in IS: 1554)** | | |
| | 1) | Test for thickness |
| | 2) | Tensile strength & Elongation before ageing (for tests after ageing see “D”) |

| D) Ageing test: | | | | |
|---|---|---|---|---|
| | **Criteria** | **Condition** | **Test Requirements** | **Remarks** |
| **PVC insulation & outer sheath:** | Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). **Tensile & elongation testing shall preferably be done with a computerized machine.** The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/ - 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard). | All sizes which meet the criteria | The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°c+/- 2°c for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS. | In case the size does not meet the requirement in accelerated ageing test **then all sizes (which had met the criteria) will be put on ageing test as per IS.** |
| | | Sizes which do not meet the criteria | Every size will be put on ageing test as per IS. | ---- |

| **E) Following tests will be carried out on completed cables as per IS on each size:** | | |
|---|---|---|
| | 1) | Insulation resistance test ( Volume resistivity method ) |
| | 2) | High voltage test |
| | | |
| **F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes):** | | |
| | 1) | Thermal stability test on PVC insulation and outer sheath |
| | 2) | Oxygen index test on outer sheath |
| | 3) | Smoke density rating test on outer sheath |
| | 4) | Acid gas generation test on outer sheath |

| | | |
|---|---|---|
| **G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable will be carried out as per following sampling plan:** | | |
| | | This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured, unarmoured) will be bunched together, as per calculations in line with the IEC. All sizes of armoured & unarmoured cables shall be covered. |
| | | |
| **H) Following tests shall be carried on one length of each size (armoured & unarmoured) of offered lot:** | | |
| | 1) | Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / outer sheath extrusion's batch number marking |
| | 2) | Measurement of Eccentricity & Ovality |

# SUB-SECTION-V-QE5

# CABLING EARTHING & LIGHTNING PROTECTION

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION | एनटीपीसी NTPC |
|---|---|---|

**MODULE NO. SQE-16**

## CABLING, EARTHING, LIGHTNING PROTECTION

| ATTRIBUTES / CHARACTERISTICS<br>ITEMS/COMPONENTS / SUB SYSTEMS | Dimension | Paint shade, paint thickness, adhesion | Pre-treatment of sheet | IP protection | Proof load* | Surface finish | Deflection test* | HV & IR | Galvanise Test (If Applicable) | Functional | Bought out items/Bill of material | Routine tests as per relevant standard & specification | Acceptance tests as per relevant standard & specification | Constructional feature as per NTPC Specification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745) | Y | Y | Y | Y | | Y | | Y | | Y | Y | Y | Y | Y |
| Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745) | Y | Y | Y | Y | | Y | | Y | Y | Y | Y | Y | Y | Y |
| Cable glands(BS-6121) | Y | | | | | | | | | | | | | Y |
| Cable lug | Y | | | | | | | | | | | | | Y |
| Lighting wire (IS-694) | Y | | | | | | | | | | | Y | | |
| Flexible conduits | Y | | | | | | | | | | | Y | | Y |
| Conduits (Galvanise & Epoxy) IS-9537 & IS-2629, 2633, 6745 | Y | | Y | | | | | | Y | | | Y | | Y |
| RCC Hume Pipe (IS-458) | | | | | | | | | | | | Y | | |
| Cable termination & straight through joint (IS 13573) | Y | | | | | | | | | | | Y | | Y |
| Cable Trays, bends, tees, crosses, Flexible supports system & accessories IS-513, 2629,2633,6745 | Y | | Y | | Y | Y | Y | | Y | | | Y | Y | Y |
| Trefoil clamp | Y | | | | | | | | | | | | | Y |
| GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633) | Y | | Y | | | | | | Y | | | Y | | Y |
| GI wire (IS-280) | Y | | | | | | | | | | | Y | | |
| Fire Sealing System ( BS –476) | | | | | | | | | | | | Y | Y | Y |

.Note:1.This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2.* Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the NTPC technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot. This test is not applicable on bends, tees & crosses.

3. Make of all items will be subject to NTPC approval.

# SUB-SECTION-V-QE6

# HT CABLES

## MV (3.3 kV / 6.6. kV / 11 kV / 33 kV) Cables

| Attributes / Characteristics<br>Item / Components / Sub System Assembly | Make, Type & T.C as per relevant standard | Dimension/surface finish | Mechanical properties | Chemical Composition | Spark Test(as applicable) | Electrical properties | Hot Set Test/ Eccentricity & Ovality | Lay length & Sequence | Armour coverage, cross over, looseness, gap between two wires | Sequential marking/ Batch marking/ surface finish/ cable length | T.S & elongation before & after ageing on outer sheath & insulation | Thermal stability on outer sheath | Metallic ( Cu ) Screening ( If applicable) | Anti termite coating on wooden drums | Constructional requirements feature as per NTPC specification | Routine & Acceptance Test as per relevant standard & NTPC specification | FRLS Test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum (IS-8130) | Y | Y | Y | Y | | Y | | | | | | | | | | | |
| Semiconducting Compound | Y | | Y | | | Y | | | | | | | | | | | |
| XLPE Compound (IS-7098 Part-II) | Y | | Y | | | Y | | | | | Y | | | | | | |
| FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810( Part 58) ,IEC-60754 Part-1) | Y | | Y | | | | | | | | Y | Y | | | | | Y |
| Triple Extrusion & curing /Manufacturing of Core | | Y | | | Y | | Y | | | | | | | | | | |
| Copper Tape | Y | Y | Y | | | Y | | | | | | | | | | | |
| Polyster tape | Y | Y | | | | | | | | | | | | | | | |
| Core Laying | | | | | | | | Y | | | | | | | | | |
| Armour wire/strip | Y | Y | Y | | | | | | | | | | | | | | |
| Copper tapping | Y | Y | | | | | | | | | | | Y | | | | |
| Inner sheath | Y | Y | | | | | | | | | | | | | | | |
| Armouring | | Y | | | | | | | Y | | | | | | | | |
| Outer Sheathing | | Y | | | | | | | | Y | | | | | | | |
| **Power Cable (Finished)** | | | | | | | | Y | Y | Y | Y | Y | | | Y | Y | Y |
| Wooden drum(IS-10418) /Steel Drum | | Y | | | | | | | | | | | | Y | Y | | |

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to NTPC approval.

| | | |
|---|---|---|
| **ROUTINE TESTS** | **Following routine tests shall be carried out on each drum of finished cables for all types & sizes.** | |
| 1) | Conductor Resistance test | |
| 2) | High voltage test | |
| 3) | Partial discharge test **(for Screened cables only)** | |
| | | |
| **ACCEPTANCE TESTS** | **Following Acceptance tests shall be carried out on each size of each type (voltage rating) of cables, in the offered lot.** | |
| **A) For Conductor (as per sampling plan mentioned in IS: 7098 Part II)** | | |
| | 1) | Annealing test (Copper) |
| | 2) | Tensile Test ( Aluminum) |
| | 3) | Wrapping Test ( Aluminum) |
| | 4) | Resistance test |
| | | |
| **B) For copper tape / Wires (as per sampling plan mentioned in IS: 7098 Part II)** | | |
| | 1) | Measurement of Dimensions |
| | 2) | Conductivity check |
| | | |
| **B) For Armour Wires / Formed Wires ( If applicable ) (as per sampling plan mentioned in IS: 7098 Part II)** | | |
| | 1. | Measurement of Dimensions |
| | 2. | Tensile Tests |
| | 3. | Elongation Test |
| | 4. | Torsion Test For Round wires only |
| | 5. | Wrapping Test |
| | 6. | Resistance Test |
| | 7. | Mass of Zinc coating test For G S wires / Formed wires only |
| | 8. | Uniformity of Zinc coating For G S wires / Formed wires only |
| | 9. | Adhesion test For G S wires / Formed wires only |
| | 10. | Freedom from surface defects |
| | | |

| C) For XLPE insulation & PVC Sheath (as per sampling plan mentioned in IS: 7098 Part II) | | |
|---|---|---|
| | 1) | Test for thickness |
| | 2) | Tensile strength & Elongation before ageing (for tests after ageing see "D") |
| | 3) | Hot set test (For XLPE insulation) |

| D) Ageing test: | | | | |
|---|---|---|---|---|
| | **Criteria** | **Condition** | **Test Requirements** | **Remarks** |
| **PVC outer sheath :** | Samples as per relevant IS, from each size of each type (voltage rating) of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). **Tensile & elongation testing shall preferably be done with a computerized machine.** The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/ - 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard). | All sizes which meet the criteria | For PVC: The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°c+/- 2°c for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS. | In case the size does not meet the requirement in accelerated ageing test **then all sizes (which had met the criteria) will be put on ageing test as per IS.** |
| | | Sizes which do not meet the criteria | Every size will be put on ageing test as per IS. | ---- |
| **XLPE Insulation** | Samples as per relevant IS, from each size of each type (voltage rating) of cables in the offered lot, will be put on ageing test as per IS. | | | |

| E) Following tests will be carried out on completed cables as per IS on each size of each type | | |
|---|---|---|
| | 1) | Insulation resistance test ( Volume resistivity method ) |
| | 2) | High voltage test |
| | 3) | Partial discharge test ( for Screened cables only ) |

| | | |
|---|---|---|
| **F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)** | | |
| | 1) | Thermal stability test on outer sheath |
| | 2) | Oxygen index test on outer sheath |
| | 3) | Smoke density rating test on outer sheath |
| | 4) | Acid gas generation test on outer sheath |
| | 5) | Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable |
| **G) Following tests shall be carried on one length of each size of each type of offered lot:** | | |
| | 1) | Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, marking of drum no. / Batch number of outer sheath extrusion |
| | 2) | Measurement of Eccentricity & Ovality |

# SUB-SECTION-V-QE7

# ELECTRIC ACTUATORS WITH INTEGRAL STARTERS

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION | एनटीपीसी NTPC |
|---|---|---|

# ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

| Test/Attributes Characteristics / ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING | RPM ® | No Load Current ® | IR & HV Test® | Mounting Dimension® | All routine Test as per Standard & Specification® | Correct Phase Sequence® | Operation & Setting of limit Switch/Torque Switch® | Stall Torque/Current (A) | Hand Wheel operation/ Auto de clutch function (A) | Function of Aux. like Potentiometer, space heater, position indicator | EPT output ® | Grease leakage ® | Local/ Remote ( Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)** | | | | | | | | | | | | | |
| Motor | Y | Y | Y | Y | Y | | | | | | | | |
| Final Testing | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.

® - Routine Test (A) - Acceptance Test Y - Test applicable

# SUB-SECTION-V-QE8

# HT SWTIGCHGEAR

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## QA TABLE FOR HT SWITCHGEAR

| ATTRIBUTES / CHARACTERISTICS → / ITEMS, COMPONENTS, SUB-SYSTEM ASSEMBLY | Make, Type, Model, Rating & TC | Electrical Properties | Mechanical properties | Chemical Properties | Dimensions & Finish | Constructional, Functional & Operational Features as per NTPC Spec. | Item to conform to relevant Standards | Pretreatment as per IS 6005 | Paint shade, thickness, adhesion & finish | Functional Checks | HV & IR Test | Degree of Protection Routine test as per NTPC spec. | CB Operation timing check | All Routine Tests as per relevant standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CRCA steel sheet/ Aluzinc*/ Zincalum*/ Galvalum* | Y | | Y | Y | Y | | Y | | | | | | | |
| Aluminum Bus bar material ( IS : 5082 ) | Y | Y | Y | Y | Y | | Y | | | | | | | |
| Copper Bus bar material ( IS : 613 ) | Y | Y | Y | Y | Y | | Y | | | | | | | |
| Bus bar Support Insulator | Y | Y | Y | | Y | | Y | | | | Y | | | |
| HT Circuit Breaker (IEC-62271-100) | Y | | | | Y | Y | Y | | | Y | | | Y | Y |
| HT Contactors ( IS : 9046 / IEC 60470) | Y | | | | Y | Y | Y | | | Y | | | | Y |
| Protection & Auxilliary Relays | Y | | | | Y | Y | Y | | | Y | | | | Y |
| HT CT's & PT's ( IS : 2705 / 3156 ) | Y | | | | Y | | Y | | | | | | | Y |
| HT Fuses ( IS : 9385 ) | Y | | | | Y | Y | Y | | | | | | | |
| Surge Arrester ( IEC : 99 –4 ) | Y | | | | Y | | Y | | | | | | | Y |
| LT Contactors ( IS : 13947) | Y | | | | Y | Y | Y | | | Y | | | | |
| Control & Selector Switches ( IS : 6875 ) | Y | | | | Y | Y | Y | | | Y | | | | |
| Indicating Meters ( IS : 1248) | Y | | | | Y | Y | Y | | | Y | | | | Y |
| Indicating Lamps ( IS : 13947) | Y | | | | Y | Y | Y | | | Y | | | | |
| Push Buttons ( IS : 4794) | Y | | | | Y | Y | Y | | | Y | | | | |
| Control Transformer ( IS : 12021 ) | Y | | | | Y | Y | Y | | | Y | | | | Y |
| LT Fuses ( IS : 13703) | Y | | | | Y | Y | Y | | | | | | | |
| Energy Meters ( IS : 722 ) | Y | | | | Y | Y | Y | | | Y | | | | Y |
| Transducers ( IEC : 60688) | Y | | | | Y | Y | Y | | | Y | | | | Y |
| Diodes | Y | Y | | | | Y | Y | | | Y | | | | |
| Terminal Blocks | Y | Y | | | | Y | Y | | | | | | | |
| Synthetic Rubber Gasket ( IS : 11149 / 3400 ) | Y | Y | | | Y | | Y | | | | | | | |
| Breaker Handling Trolley | Y | | | | Y | Y | | | Y | Y | | | | |
| HT Switchgear Panel IEC-62271-200) | Y | | | | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought Out Items will be subject to NTPC approval.
3. Temperature rise test reports for diode plates with actual heat sink will be verified.

*. CRCA Galvanized steel with metal coating composed of Al (55%), Zn (43.4%) & Si (1.6%),

# SUB-SECTION-V-QE9

# LT SWTIGCHGEAR

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION | एनटीपीसी NTPC |
|---|---|---|

SQE _10

# LT SWITCHGEAR

## ( MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

| ATTRIBUTES / CHARACTERIS-TICS → / ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY ↓ | Make, Model, Type, Rating & TC | Dimensions & Finish | Electrical properties | Mechanical Properties | Chemical properties | Functional & Operational Features as per NTPC Spec. | Item to conform to relevant | Pretreatment as per IS 6005 | Paint Shade, Adhesion, Thickness & | Functional Checks | Milli-volt drop Test | IR – HV – IR Test | Degree of Protection Routine test as per NTPC spec | All Routine tests as per NTPC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sheet Steel (IS : 513) | Y | Y | | Y | Y | | Y | | | | | | | |
| Aluminum Bus bar Material (IS : 5082) | Y | Y | Y | Y | Y | | Y | | | | | | | |
| Copper Bus bar Material (IS : 613) | Y | Y | Y | Y | Y | | Y | | | | | | | |
| Support Insulator | Y | Y | Y | Y | | | Y | | | | | | | |
| Air Circuit Breaker ( IS: 13947) | Y | Y | | | | Y | Y | | | Y | Y | | | Y |
| Energy Meters ( IS : 13010, 13779 ) | Y | Y | | | | Y | Y | | | Y | | | | Y |
| Power & Aux. Contactors (IS : 13947 ) | Y | Y | | | | Y | Y | | | Y | | | | |
| Protection & Aux. Relays (IS : 3231) (IEC 60255 / IEC 61850) | Y | Y | | | | Y | Y | | | Y | | | | Y |
| Control & Selector Switches ( IS : 13947) | Y | Y | | | | Y | Y | | | Y | | | | |
| CT's & PT's ( IS 2705 / 3156) | Y | Y | | | | | Y | | | | | | | Y |
| MCCB ( IS : 13947 ) | Y | Y | | | | | Y | | | Y | | | | |
| Indicating Meters ( IS : 1248 ) | Y | Y | | | | Y | Y | | | Y | | | | Y |
| Indicating Lamps ( IS : 13947 ) | Y | Y | | | | Y | Y | | | Y | | | | |
| Air Break Switches ( IS : 13947 ) | Y | Y | | | | Y | Y | | | Y | | | | |
| Control Terminal Blocks | Y | Y | | | | Y | Y | | | | | | | |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

# LT SWITCHGEAR

**( MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)**

| ATTRIBUTES / CHARACTERIS-TICS → / ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY ↓ | Make, Model, Type, Rating & TC | Dimensions & Finish | Electrical properties | Mechanical Properties | Chemical properties | Functional & Operational Features as per NTPC Spec. | Item to conform to relevant Standards | Pretreatment as per IS 6005 | Paint Shade, Adhesion, Thickness & | Functional Checks | Milli-volt drop Test | IR – HV – IR Test | Degree of Protection Routine test as per NTPC spec | All Routine tests as per NTPC spec. & IS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuse ( IS 13703) | Y | Y | | | | Y | Y | | | | | | | |
| Control Transformer ( IS : 12021) | Y | Y | | | | Y | Y | | | Y | | | | Y |
| Push Buttons ( IS : 4794 ) | Y | Y | | | | Y | Y | | | Y | | | | |
| Transducer ( IEC : 60688) | Y | Y | | | | Y | Y | | | Y | | | | Y |
| MCB ( IS : 8828) | Y | Y | | | | Y | Y | | | Y | | | | |
| Breaker Handling Trolley | Y | Y | | | | Y | | | Y | Y | | | | Y |
| Synthetic Rubber Gasket (IS : 11149 ) | Y | Y | | Y | Y | | Y | | | | | | | |
| LT SWITCHGEAR ( IS : 8623 ) | Y | Y | | | | Y | Y | Y | Y | Y | | Y | Y | Y |

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## LT BUSDUCT

| ATTRIBUTES , CHARACTERISTICS → / ITEM, COMPONENTS, SUB SYSTEM ASSEMBLY ↓ | Dimension & Surface Finish | Make, Type, Rating & TC | Electrical Properties | Mechanical Properties | Chemical Properties | Item to conform to relevant IS | WPS Approval, Welder Qualification | Weld Quality Check ( DP test & x-ray | Paint Shade, Thickness, Adhesion & | Tightness by Torque measurement | Electrical Clearances | Galvanizing Test as per IS 2629/ 2633/ | IR – HV – IR Test | Phase Sequence Check | Degree of Protection routine test as per NTPC spec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum Sheets / Plates / Strips / Flexibles / tubes ( IS : 5082 / 737 ) | Y | Y | | Y | Y | Y | Y | Y | | | | | | | |
| CRCA Flats / ISMC ( IS 2062 ) | Y | Y | | Y | Y | Y | | | | | | | | | |
| Neoprene / Synthetic Rubber Gaskets ( IS 11149 / 3400 ) | Y | Y | | Y | Y | | | | | | | | | | |
| Rubber Bellows (IS : 3400) | Y | Y | | Y | Y | | | | | | | | | | |
| Support Insulator ( BS : 2782, IEC : 660, IS : 10912 ) | Y | Y | Y | Y | | | | | | | | | | | |
| Galvanized Structure & GI Earthing Flat (IS : 2629 / 2633 / 4749 ) | Y | Y | | | | Y | | | | | | Y | | | |
| Space Heater & Thermostat | | Y | Y | | | | | | | | | | Y | | |
| LT Busduct (IS : 8623 PART 2) | Y | Y | | | | Y | Y | Y | Y | Y | Y | | Y | Y | Y |

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

# SUB-SECTION-V-QE10

# DIESEL GENERATORS

**DIESEL GENRATOR SET SQE_18**

## DIESEL ENGINE

| TESTS/CHECKS / ITEMS/COMPONENTS | Material Test | DP/MPI | UT( On forging and piston Bonding) | Balancing | Hydraulic/water fill test | Assy./fit up | Dimension | Functional/Operation test | Performance test as per BS-5514/or equivalent IS/ISO- Standard including Governing Test for 3 hors at full load and one hr at 10% overload | Fuel consumption, rated power measurement,rated speed | All other tests( if applicable) as per Spec./ relevant standard |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Crank shaft | Y | Y | Y | Y | | | | | | | |
| Cylinder blocks/heads | Y | | | | Y | | | | | | |
| Liner/ Radiator | Y | | | | Y | | | | | | |
| Rotating/moving parts other than crank shaft | Y | Y | | | | | | | | | |
| Piston | Y | Y | Y | | | | | | | | |
| Diesel Engine | | | | | | Y | Y | Y | Y | Y | Y |

Note:
1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents in line in case required as per agreement with NTPC.
2. Make of all major BOIs will be subject to NTPC approval.

## ALTERNATOR

| TESTS/CHECKS / ITEMS/COMPONENTS | Visual | Dimensional | Make/Type/Rating/TC/General Physical Inspection | Mech/Chem. Properties | NDT /DP/MPI/UT | Metallography | Electrical Characteristics | Welding/Brazing(WPS/PQR) | Heat Treatment | Magnetic Characteristics | Hydrualic/Leak/Pressure Test | Thermal Characteristics | Run out | Dynamic Balancing | All tests as per IS--4722 | Vibration | Over speed | Tan delta, shaft voltage & polarisation index test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plates for stator frame,end shield, spider etc. | Y | Y | Y | Y | | | | | Y | | | | | | | | | |
| Shaft | Y | Y | Y | Y | Y | Y | | | Y | | | | | | | | | |
| Magnetic Material | Y | Y | Y | Y | Y | | Y | | | Y | | Y | | | | | | |
| Rotor Copper/Aluminium | Y | Y | Y | Y | | Y | Y | | Y | | | | | | | | | |
| Stator copper | Y | Y | Y | Y | | | Y | | Y | | | Y | | | | | | |
| SC Ring | Y | Y | Y | Y | Y | Y | Y | Y | Y | | | | | | | | | |
| Insulating Material | Y | | Y | Y | | | Y | | | | | Y | | | | | | |
| Tubes for Cooler | Y | Y | Y | Y | Y | | | | Y | | Y | | | | | | | |
| Sleeve Bearing | Y | Y | Y | Y | Y | | | | Y | | Y | | | | | | | |
| Stator/Rotor, Exciter Coils | Y | Y | Y | | | | Y | Y | | | | | | | | | | |
| Castings, stator frame,terminal box and bearing housing etc. | Y | Y | Y | Y | Y | | | Y | | | | | | | | | | |
| Fabrication & machining of stator, rotor, terminal box | Y | Y | | | Y | | | | Y | | | | | | | | | |

## ALTERNATOR

| TESTS/CHECKS / ITEMS/COMPONENTS | Visual | Dimensional | Make/Type/Rating/TC/General Physical Inspection | Mech/Chem. Properties | NDT /DP/MPI/UT | Metallography | Electrical Characteristics | Welding/Brazing(WPS/PQR) | Heat Treatment | Magnetic Characteristics | Hydrualic/Leak/Pressure Test | Thermal Characteristics | Run out | Dynamic Balancing | All Routine tests as per IS-/IS-4722 | vibration | Over speed | Tan delta, shaft voltage & polarisation index test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wound stator | Y | Y | | | | | Y | Y | | | | | | | | | | |
| Wound Exciter | Y | Y | | | | | Y | Y | | | | | | | | | | |
| Rotor complete | Y | Y | | | | | Y | | | | | | Y | Y | | | | |
| Exciter, Stator, Rotor, Terminal Box assembly | Y | Y | | | | | Y | | | | | | | | | | | |
| Accessories, RTD, BTD,CT,AVR. Brushes, Diodes,Space heater, antifriction bearing, cable glands, lugs, gaskets etc. | Y | Y | Y | | | | | | | | | | | | | | | |
| Alternator ( IS 4722) | Y | Y | Y | | | | | | | | | | | | Y | Y | Y | Y1 |

Note: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and Procedure along with relevant supporting documents during QP finalisation.

2. Make of all major BOIs will be subject to NTPC approval.

Y1= for HT Machines only.

## FINAL ASSEMBLY

| TESTS/CHECKS / ITEMS/COMPONENTS | Material Test | Dimension | WPS/PQR/Welding | NDT/DP/MPI/UT | Check completeness | Hydraulic/Leak/Pressure test | Functional Tests | All routine test as per Spec/ IS | No load test for 5 min & partial load for one hour of the DG set assembly | Clearances & Alignment |
|---|---|---|---|---|---|---|---|---|---|---|
| Base frame | Y | Y | Y | Y | Y | | | | | |
| Fuel Tank | Y | Y | Y | Y | Y | Y | | | | |
| Battery | | | | | | | | Y | | |
| Battery Charger | | | | | | | | Y | | |
| Control Panel | | | | | | | | Y | | |
| Assembled DG Set | | Y | | | Y | | Y | | Y | Y |

NOTES:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during finalisation of QP.
2. Make of all major Bought Out Items will be subject to NTPC approval.

# SUB-SECTION-V-QE11

# AUXILIARY TRANSFORMERS

## AUXILIARY / LT TRANSFORMER

| Attributes / Characteristics / Items/Components Sub Systems | Visual & Dimensional Checks | Mechanical properties | Electrical strength | Thermal properties | Chemical Composition | Compatibility with oil | NDT / DPT / MPI / UT | Ageing Test. | Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test | Make / Type / Rating / Model / TC / General Physical Inspection. | Functional check | WPS & PQR | Routine Test as per relevant standard / NTPC Specification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tank, H.V. & L.V. Cable Box / Flange throat | Y | Y | | | | | Y | | | | | Y | |
| Conservator / Radiator / Cooler / Pipes | Y | Y | | | | | Y | | | | | | |
| Copper Conductor (IS:191) | Y | Y | Y | | Y | | | | | | | | |
| Insulating Material | Y | Y | Y | Y | Y | Y | | | | | | | |
| CRGO Lamination & Built Core | Y | Y | Y | | Y | Y | | | | Y | | | |
| Bushing / Insulator (IS:2544 / 5621) | Y | Y | | | | | | | | Y | | | Y |
| Gasket | Y | Y | | | Y | Y | | Y | | Y | | | Y |
| Transformer Oil (IEC296) | | | Y | | | | | | | | | | Y |
| OLTC / Off-Circuit Tap Changer | Y | | | | | | | | | Y | | | Y |
| Core Coil Assembly & Pre-tanking | Y | | | | | | | | Y | Y | | | |
| Marshalling Box | Y | | | | | | | | | Y | Y | | Y |
| WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Valves | Y | | | | | | | | | Y | Y | | |
| Welding (ASME Sect-IX) | Y | | | | | | Y | | | | | Y | |
| Complete Transformer (IS:2026/ IEC-60076) | Y | | | | | | | | | | | | Y |

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2) All major Bought Out Items will be subject to NTPC approval.

# SUB-SECTION-V-QE12

# ELEVATOR

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

**Passenger/ Service Elevators**

| TEST /CHECK / ITEM | Material Test | DPI/MPI | Ultrasonic Test | Dimensions/Physical | Functional/ Operational Test/ Run Test | Performance Test | Other Tests | All routine tests as per applicable standard | Plain shade, thickness & adhesion | Assembly/fit up |
|---|---|---|---|---|---|---|---|---|---|---|
| **Shaft/ /Gears/Pinion/Pulley/Sheave** | Y | Y | Y | Y | | | | | | |
| **Spring** | Y | Y | Y | Y | | | | Y | | |
| **Plates** | Y | | | Y | | | | | | |
| **Wire rope** | | | | Y | | | Y5 | | | |
| **Safety device** | | | | | | | | Y | | |
| **Geared Machine** | | | | | Y | | | | | |
| **VVVF Drive** | | | | | Y | | | Y | | |
| **Power, Control & Trailing Cables** | | | | | | | | Y4 | | |
| **Control Panel** | | | | Y | | | | | Y | |
| **ARD System** | | | | | Y | | | Y | | |
| **Electrical motor** | | | | | | | | Y | | |
| **Controller assembly with VVVF drive** | | | | | **Y** | | Y3 | | | |
| **Complete Elevator** | | | | Y | Y1 | Y1 | Y2 | | | Y |

Y1 –Test to Be Done At Site

Y2 - Load/Overload Test to Be Done At Site as Applicable.

Y3 – Burn in test on electronic card

Y4 – Routine tests including FRLS tests as per Tech. Spec.

Y5- Test report as per relevant std.

NOTE: 1. This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the applicable practices and procedures followed along with relevant supporting documents during QAP finalization.

2. Makes of all bought out items shall be subject to NTPC approval

# SUB-SECTION-V-QE13

# VFD MODULE

| VFD MODULE SQE_28 | | | | |
|---|---|---|---|---|
| **ATTRIBUTES / CHARACTERISTICS** / **ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY** | Visual & Dimensional checks | Make / Type / Rating etc. | Final Inspection as ISS / IEC | Remarks |
| HT Breaker (IEC 56) | Y | Y | Y | |
| DC Reactor | Y | Y | | For details refer table for DC Reactor |
| Transformer | Y | Y | | For details refer table for Transformer |
| Motor | Y | Y | | For details refer separate table for Motor |
| VFD Panel | Y | Y | | For details refer table for VFD |

Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalisation.

2) Make of all major Bought Out Items will be subject to NTPC approval.

## DC REACTOR

| ATTRIBUTES / CHARACTERISTICS / ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY | Visual | Dimensional | Mech. & Chem. Property | Electrical Characteristics | Pretreatment by Seven Tank | Painting by Stove Enameling | Final Inspection as per IS-2026 | Welding/NDT |
|---|---|---|---|---|---|---|---|---|
| Winding Material (Aluminium) | Y | Y | Y | Y | | | | |
| Insulation Material | Y | Y | | Y | | | | |
| Sheet Steel | Y | Y | Y | | | | | |
| Winding | Y | Y | | Y | | | | |
| Fabrication of Enclosures | Y | Y | | | Y | Y | | Y |
| Assembly | Y | Y | | | | | | |
| Routine Tests | Y | Y | | | | | Y | |

Note : 1) This is an indicative list of tests/checks. The manufacturer to furnish a detailed Quality Plan indicating their practice & procedure along with relevant supporting documents during QP finalisation for all items.

2) All major Bought Out Items will be subject to NTPC approval.

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## TRANSFORMER (OIL FILLED)

| Attributes / Characteristics / Items/Components Sub Systems | Visual & Dimensional Checks | Mechanical properties | Electrical strength | Thermal properties | Chemical Composition | Compatibility with oil | NDT / DPT / MPI / UT | Ageing Test. | Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test | Make / Type / Rating / Model / TC / General Physical Inspection. | WPS & PQR | Routine Test as per relevant test | Routine Test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tank, H.V. & L.V. Cable Box / Flange throat | Y | Y | | | | | Y | | | | | | |
| Conservator / Radiator / Cooler / Pipes | Y | Y | | | | | Y | | | | | | |
| Copper Conductor (IS:191) | Y | Y | Y | | Y | | | | | | | | |
| Insulating Material | Y | Y | Y | Y | Y | Y | | | | | | | |
| CRGO Lamination & Built Core | Y | Y | Y | | Y | Y | | | | | | | |
| Bushing / Insulator ( IS:2544 / 5621) | Y | Y | | | | | | | | Y | | Y | |
| Gasket | Y | | | | Y | Y | | Y | | | | Y | |
| Transformer Oil ( IS:335 / IEC296) | | | | | | | | | | | | Y | |
| Off-Circuit Tap Changer | Y | | | | | | | | | Y | | | |
| Core Coil Assembly & Pre-tanking | Y | | | | | | | | Y | | | | |
| Marshalling Box | Y | Y | | | | | Y | | | | | Y | |
| WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve, | Y | | | | | | | | | Y | | | |
| Welding (ASME Sect-IX) | Y | | | | | | | | | | Y | | |
| Complete Transformer (IS:2026/ IEC-60076) | Y | | | | | | | | | | | | Y |

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2) All major Bought Out Items will be subject to NTPC approval.

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## DRY TYPE TRANSFORMER

| Attributes / Characteristics / Items/Components Sub Systems | Visual & Dimensional check | Mechanical properties | Electrical strength | Thermal Properties | Chemical Properties | NDT / DP / MPI | Voltage Ratio, Vector Group & Polarity | Make / Type / Rating / Model /TC / General Physical Inspection | WPS & PQR | Routine Test as per relevant standard | Measurement of capacitance & tan delta between winding | Routine Test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Enclosure door, H.V. & L.V. Cable Box / Flange Throat | Y | Y | | | | | | Y | | | | |
| Copper Conductor | Y | Y | Y | | Y | | | | | | | |
| Insulating Material | Y | | | Y | Y | | | | | | | |
| CRGO Lamination & Built Core | Y | | | | | | | | | | | |
| Bushing /Insulator ( IS:2544 / 5621) | Y | | | | | | | Y | | Y | | |
| Gasket | Y | | | | | | | Y | | Y | | |
| Off-Circuit Tap Changer | Y | | | | | | | Y | | | | |
| Core Coil Assembly | Y | | | | | | Y | | | | | |
| Marshalling Box | Y | | | | | | | | | Y | | |
| WTI, Thermister, Terminal Connector | Y | | | | | | | Y | | | | |
| Welding | | | | | | | | | Y | | | |
| Complete Transformer (IS:11171 / IEC 60076) | Y | | | | | | | | | | Y | Y |

Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item.

2. All major Bought out Items will be subject to NTPC approval.

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## VFD PANEL

| Attributes Characteristics / Item Components Sub System Assembly | Electrical Properties | Mechanical Properties | Chemical Properties | Dimensions / Finish | Type/ Rating/Functional check | HV/IR | Routine test as per relevant std. | Constructional Features | IS:6005 ,Seven tank process | Paint finish/ shade/thickness | Mountings / BOM/ Make, Completeness | Interlock Functional & Operation Testing / Simulation check | Degree of Protection Test | Final testing as per Relevant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sheet Steel (IS-513) | | Y | Y | Y | | | | | | | | | | |
| Aluminum / Copper Bus-bar(IS-5082/IS-613/IS-1987) | Y | Y | Y | Y | | | | | | | | | | |
| Support Insulator (BS-2782/IEC-660/IS-10912) | Y | Y | Y | Y | | | | | | | | | | |
| Control / Selector Switch(IS-6875) | | | | | Y | Y | Y | | | | | | | |
| Contactor/ MCB(IS-13947) | | | | | Y | Y | Y | | | | | | | |
| O/L Protection relays(IS-3231) | | | | | Y | | Y | | | | | | | |
| C.T /V.T/ Indicating Meter(IS-2705/3156/1248) | | | | | Y | Y | Y | | | | | | | |
| Fuse/ Fuse carrier(IS-13703) | | | | | Y | Y | Y | | | | | | | |
| Terminals/lugs/pvc wires(IS-13947//IS-694) | Y | | | Y | Y | Y | Y | | | | | | | |
| Timers(IS-3231) | | | | | Y | Y | Y | | | | | | | |
| Push Button/ Lamp/ (IS-6875) | | | | | Y | Y | Y | | | | | | | |
| Control Transformer (IS-12021) | | | | | Y | Y | Y | | | | | | | |
| Mimic, Annunciater | | | | | Y | | Y | | | | | | | |
| GASKET(IS-11149) | | Y | Y | Y | Y | | Y | | | | | | | |
| Fabrication | | | | | | | | Y | | | | | | |
| Pretreatment & Painting | | | | | | | | | Y | Y | | | | |
| VFD panel | | | | | | | | | | Y | Y | Y | Y | Y |

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. All major Bought Out Items will be subject to NTPC approval.

# SUB-SECTION-V-QE14

# STATION LIGHTING

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## STATION LIGHTING SQE_17

| Item Components / Sub System / Assembly — Attributes / Characteristics | Make, Type , Rating/ TC | Dimension | Pre-Treatment of sheat | Paint Shade Thickness Adhesion & Finish | Galvanization Tests | IP Test | Bought Out Items/ Bill of Material | HV & IR | Functional Check as per spec. | Constructional Feature as per NTPC spec. | Routine Test as per relevant std and spec | Acceptance Test as per relevant std and spec | Item to conform to relevant standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Luminaries (IS-10322 Part-5 Sec.1 ( non –LED type) | Y | | | | | Y | | Y | | | Y | Y | Y |
| Electronic Ballast | Y | | | | | | | | | | Y | Y | Y |
| Lighting Wire (IS-694) | Y | | | | | | | | | | Y | | |
| Fans (IS-374) | Y | | | | | | | | | | Y | | |
| Pole (IS-2713) | Y | | | Y | | | | | | Y | Y | Y | |
| Lamps (IS-9800, IS-9974) | Y | | | | | | | | | | Y | Y | |
| Lighting Mast (with raise & lower lantern type) | Y | Y | | | Y | | | | | Y | Y | Y | |
| Wall Mounted Lighting Panel (IS-513, IS-5) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | |
| Switch Box/ Junction Box/Receptacles/ Local Push Button Station / Lighting Panel (IS-513, 2629, 2633, 4759, 6745) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | |
| Cable Gland (BS-6121) | Y | Y | | | | | | | | | Y | | |
| Cable Lug (IS-8309) | Y | Y | | | | | | | | | Y | | |
| Flexible Conduit | Y | | | | | | | | | | Y | | |
| Lighting Transformer (IS-11171) | Y | | | | | | | | | Y | Y | | |
| Epoxy & Galvanised Conduit (IS-9537, 2629, 2633, 4759, 6745) | Y | Y | | | | | | | | | Y | | Y |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

**LED Luminaire quality requirements:**

1) LED modules to conform to IS: 16103 part 2. Manufacturer to issue a certificate of compliance for the same.

2) Control gear to conform to IS 15885 part 2 section 13. Manufacturer to issue a certificate of compliance for the same.

3) LED luminaire to conform to IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.

4) LED luminaire marking to be as per IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.

5) Acceptance tests as per IS 16107 part 2 section 1 to be carried out on LED luminaire except long duration tests i.e. a) Chromaticity coordinates & correlated color temperature (CCT); b) Color rendering index (CRI). Manufacturer will submit a COC for above tests i.e. CCT & CRI

6) LED driver make, model, type & rating may be as per recommendations of LED module manufacturer.

Notes:
1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought Out Items will be subject to NTPC approval.

# (CONTROL & INSTRUMENTATION SYSTEM)

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

# SUB-SECTION-V-QC1

# MEASURING INSTRUMENTS
# (PRIMARY & SECONDARY

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**

| TESTS / ITEMS | Dimensions (R) | Make, Model, Type, Rating (R) | Process / Electrical connection (R) | Calibration (R) | Test as per standard(R) | Insulation Resistance (R) | IBR Certification (if applicable )(R) | Hydro Test(R) | Material Test certificate ® |
|---|---|---|---|---|---|---|---|---|---|
| 1. PR Gauge (IS-3624) | Y | Y | Y | Y | Y | | | | |
| 2. Temp. Gauge (BS-5235) | Y | Y | Y | Y | Y | | | | |
| 3. Pr./D.P.Switch(BS-6134) | Y | Y | Y | Y | Y | Y | | | |
| 4. Electronic Transmitter(IEC-60770) | Y | Y | Y | Y | Y | Y | | | |
| 5. Temp. Switch | Y | Y | Y | Y | Y | Y | | | |
| 6. Recorder(IS-9319/ANSI C-39.4) | Y | Y | Y | Y | Y | Y | | | |
| 7. Vertical indicators | Y | Y | Y | Y | | Y | | | |
| 8. Digital Indicators | Y | Y | Y | Y | | Y | | | |
| 9. Integrators | Y | Y | Y | Y | | | | | |
| 10. Electrical Metering Instrument (IS-1248) | Y | Y | Y | Y | Y | Y | | | |
| 11. Transducer (IEC-688) | Y | Y | Y | Y | Y | Y | | | |
| 12. Thermocouples (IEC – 754 / ANSI-MC-96.1) | Y | Y | Y | Y | Y | Y | | | |
| 13. RTD(IEC-751) | Y | Y | Y | Y | Y | Y | | | |
| 14. Thermowell | Y | | Y | | | | Y | Y | Y |

R-Routine Test A- Acceptance Test Y – Test applicable

: Note: **1) Detailed procedure of Environmental Stress Screening shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization**

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**

| TESTS / ITEMS | Dimensions (R) | Make, Model, Type, Rating (R) | Process / Electrical connection (R) | Calibration (R) | Requirement as per standard (R) | WPS approval (A) | Non-destructive testing (R) | Calculation for accuracy (R) | Insulation Resistance (R) | IBR Certification as applicable (R) | Hydro test (R) | Material test certificate (A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15. Cold junction compensation box | Y | Y | Y | Y | | | | | Y | | | |
| 16. Orifice plate(BS-1042) | Y | Y | Y | Y * | Y | Y ** | Y ** | | | Y | Y ** | Y |
| 17. Flow nozzle(BS-1042) | Y | Y | Y | Y * | Y | Y | Y | | | Y | Y | Y |
| 18. Impact head type element | Y | Y | Y | | | | | Y | | | | Y |
| 19. Level transmitter/float type switch | Y | Y | Y | Y | | | | | Y | Y | Y | Y |
| 20. Analysers | Y | Y | Y | Y | | | | | | | | |
| 21. Dust emission monitors | Y | Y | Y | Y | | | | | | | | |
| *Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated. | | | | | | | | | | | | |
| ** If applicable | | | | | | | | | | | | |

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

# SUB-SECTION-V-QC2

# PROCESS CONNECTION & PIPING

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## Process, Connection & piping FOR C&I SYSTEMS

| TESTS / ITEMS | Visual ® | GA, BOM, Layout of component & construction feature® | Dimension ® | Paint Shade/thickness ® | Flattening, flaring, hydrotest, hardness check as per ASTM standard | Component Ratings ® | Wiring ® | Make, Model, Type, Rating® | IR & HV ® | Review of TC for instrument/devices (R) | Accessability of TBs/Devices ® | Illumination,grounding ® | Tubing ® | Leak/Hydro test(A) | Chemical/physical properties of material (A) | Proof pressure test,Dismantling & reassembly test,Hydrulic impulse and vibration test (R) | Tests as per standards & specification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Local Instrument enclosure | Y | Y | Y | Y | | Y | Y | Y | Y | Y | Y | Y | Y | Y | | | |
| Local instruments racks | Y | Y | Y | Y | | Y | Y | Y | Y | Y | Y | Y | Y | Y | | | |
| Junction Box | Y | Y | Y | Y * | | Y | | Y | Y | | | | | | | | |
| Gauge Board | Y | Y | Y | Y | | Y | | Y | | Y | | | Y | Y | | | |
| Impulse pipes and tubes | Y | | Y | | Y | | | Y | | | | | | | Y | | |
| Socket weld fittings ANSI B-16.11 | Y | | Y | | | | | Y | | | | | | | Y | | Y |
| Compression fittings | Y | | Y | | | | | Y | | | | | | Y | Y | Y | |
| Instrument valves & Valve manifolds | Y | | Y | | | | | Y | | | | | | Y | Y | | |
| Copper tubings ASTM B75 | Y | | | | | | | Y | | | | | | | | | Y |

*-applicable for painted junction boxes.

Note: R-Routine Test A- Acceptance Test Y – Test applicable

Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

# SUB-SECTION-V-QC3

# INSTRUMENTATION CABLES

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

*INSTRUMENTATION CABLE*

| TESTS / ITEMS | Conductor Resistance ® & (A) | High Voltage ® & (A) | Insulation Resistance ® & (A) | Constructional detail, dimensions (A) | Outer-Sheathe/core marking, end sealing (A) | Thermal Stability (A) + | Visual, Surface finish (A) + | Electrical Parameters ** (A) + | Persulphate Test (A) + | Overall/Coverage/Continuity (A) | Swidesh chimney Test (SS-4241475) (A) ++ | FRLS Test * (A) ++ | Tensile & Elongation before & after aging (A) ++ | Vol. Resistivity. at room & Elevated Temp. (A) ++ | Spark test report review ® |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Instrument cable twisted and shielded** | | | | | | | | | | | | | | | |
| Conductor(IS-8130) | Y | | | Y | | | Y | | | | | | | | |
| Insulation(VDE-207) | | | | Y | Y | Y | Y | | | | | | Y | | Y |
| Pairing/Twisting | | | | Y | Y | | Y | | | | | | | | |
| Shielding | | | | Y | | | Y | | | Y | | | | | |
| Drain wire | Y | | | Y | | | Y | | Y | Y | | | | | |
| Inner Sheath | | | | Y | Y | Y | Y | | | | | Y | Y | | |
| Outer Sheath | | | | Y | Y | Y | Y | | | | | Y | Y | | |
| Over all cable | Y | Y | Y | Y | Y | | Y | Y | | | Y | | | Y | |
| Cable Drums(IS-10418) | | | | Y | | | Y | | | | | | | | |

**Note :** High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

**Note :** This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.

**Note :** ® - Routine Test A - Acceptance Test Y - Test Applicable

**Note :** Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index ( ASTM D-2863), Smoke Density Rating ( ASTM – D 2843), HCL Emission ( IEC-754-1)
- ** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk ( As applicable)

\+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

# SUB-SECTION-V-QC4

# CONTROL DESK PLC PANEL SMOKE DETECTOR FIRE ALARM & CONTROL SYSTEM

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

CONTROL DESK, PLC PANEL, SMOKE DETECTOR, FIRE ALARM & CONTROL SYSTEM

| TESTS / ITEMS | Visual ® | GA, BOM ,Lay Out of components ® | Dimensions ® | Paint Shade/Thickness/Adhesion ® | Alignment of Section ® | Component Rating/ Make / Type ® | Wiring ® | IR & HV ® | Review of TC for instruments/ Devices/ Recorders, Indicators/ osaic Items/ Transducers ® | Accessibility of TBS/ Devices ® | Illumination ® | Functional Check for Control Element , | Mimic ® | Test as per IEC 1131 ® * | Test as per Std ® & ( A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Control Desk | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | | |
| 2. Annunciation/ Control/ PLC Panel | Y | Y | Y | Y | | Y | Y | Y | Y | Y | Y | | | Y | Y |
| 3.Smoke Detectors ( UL-268,EN-54 PT-7), Heat Detectors( UL-521/EN 54 PT-5 ) Annunciation/ Control Panel ( UL -864, EN-54, PT-2) | | | | | | | | | | | | | | | Y |

**Note:** 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents.

- *Applicable for PLC
- Y - Test Applicable , ® - Routine Test (A) - Acceptance Test

# SUB-SECTION-V-QC5

# POWER SUPPLY SYSTEM

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## POWER SUPPLY FOR C&I SYSTEMS (UPS/BATTERY/BATTERY CHARGER/ACDB/DCDB)

| ITEMS \ TESTS | Visual/dimension/rating/ Paint Adhesion/ Thickness (R) | General arrangement/BOM/make of components /Mimic ® | Efficiency ,regulation(R) | Input voltage variation (A) | Out put voltage and frequency adj.range(A) | Premilinary light load test(R) | Load transfer retransfer test (R) * | AC input faliure and return test (R) | Parralel operation and current divison(R) | Relative harmonic content(R) | Restart with PRI A.C and battery (separately)(R) | System transfer and retransfer (R)* | Asynchronous transfer(R) | Ripple content(R) | Load limiter operation (R) | IR/HV(R) | Tests as per standard &specification (R)&(A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **UPS/CONVERTER (IEC-146 PT-4)** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **VOLTAGE STABILISER** | Y | Y | Y | Y | Y | | | | | Y | | Y | | | | Y | |
| **LEAD ACID BATTERY(TUBLAR )-IS-1651** | | | | | | | | | | | | | | | | | Y |
| **LEAD ACID BATTERY (PLANTE)-IS-1652** | | | | | | | | | | | | | | | | | Y |
| **NICKEL CADMIUM BATTERY(IS-10918/IEC-623)** | | | | | | | | | | | | | | | | | Y |
| **SMF BATTERY** | | | | | | | | | | | | | | | | | Y |
| **ACDB/DCDB** | Y | Y | | | | | | | | | | | | | | Y | Y |
| **BATTERY CHARGER** | Y | Y | Y | Y | Y | | | | Y | | | | | Y | Y | Y | Y |

R-Routine Test A- Acceptance Test Y – Test applicable

* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded .

**Note**: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

# SUB-SECTION-V-QC6

# CONTROL VALVE ACTUATORS AND ACCESSORIES

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION |
|---|---|

## CONTROL VALVE ACTUATORS AND ACCESSORIES.

| TESTS / ITEMS | Make,model, tag (r) | Dimension® | Surface finish® | Heat treatment® | Material test certificates® | Ibr certificates® | Hydraulic test® | Ut/radiography for >900 lb rating® | Mpi/dp® | Pressure resistance® | Seat leakage® | Timing open/close® | Linearity/hysterisis® | Functional test, review for make and tc of accessories® |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CONTROL VALVE AND ACTUATOR** | | | | | | | | | | | | | | |
| Overall | Y | Y | Y | | | Y | Y | | | | Y | Y | Y | Y |
| Body | | Y | Y | Y | Y | | | Y | Y | Y | | | | |
| Bonnet | | Y | Y | Y | Y | | | | | | | | | |
| Trim | | Y | | | Y | | | Y* | | | | | | |
| Pneumatic actuator | Y | Y | | | | | | | | Y | | | | |
| Electro pneumatic positioner | Y | | | | | | | | | | | | | Y |

R- ROUTINE TEST  A - ACCEPTANCE TEST  Y - TEST APPLICABLE

Y* - **UT ON SPINDLE DIA >= 40 MM.**

NOTE : **1)** Detailed procedure of environmental stress screening test shall be as per quality assurance programme general technical conditions

2) This is an indicative list of tests/checks. the manufacture is to furnish a detailed quality plan indicating his practice & procedure along with relevant supporting documents during QP finalisation for all item.

# SUB-SECTION-V-QC7

# ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS

| | |
|---|---|
| **LOT-IA PROJECTS**<br>**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI**<br>**BID DOCUMENT NO.: CS-0011-109(1A)-2** |

| CLAUSE NO. | QUALITY ASSURANCE & INSPECTION | NTPC |
|---|---|---|

## ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

| Test/Attributes / Characteristics / ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING | RPM ® | No Load Current ® | IR & HV Test® | Mounting Dimension® | All routine Test as per Standard & Specification® | Correct Phase Sequence® | Operation & Setting of limit Switch/Torque Switch® | Stall Torque/Current (A) | Hand Wheel operation/ Auto de clutch function (A) | Function of Aux. like Potentiometer, space heater, position indicator | EPT output ® | Grease leakage ® | Local/ Remote ( Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334) | | | | | | | | | | | | | |
| Motor | Y | Y | Y | Y | Y | | | | | | | | |
| Final Testing | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

**Note:** 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure finalized during QP finalization

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents**.**

**® - Routine Test (A) - Acceptance Test Y - Test applicable**

# (CIVIL WORKS)

## SUB-SECTION-V-QD1

| Clause No | QUALITY ASSURANCE PROGRAMME |
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## SAMPLING, TESTING AND QUALITY ASSURANCE FOR CIVIL WORKS

**1.0.0 INTRODUCTION**

1.1.0 This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification including excavation and filling, cast in situ concrete and allied works, fabrication and erection of structural steel works, masonry / sheeting and allied works, finishing items etc.

1.2.0 This part of the technical specification shall be read in conjunction with other Parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.

1.3.0 All tests required for all materials (bought by Contractor) and workmanship shall be done / got done by the contractor at his own cost. The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part.

1.4.0 The Contractor shall provide the facilities whatsoever required and also bear the cost for all sampling, testing and quality assurance in the field and in the laboratory. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian standards and / or international standards and this technical specification. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All sampling shall be done in the presence of the Engineer or his authorised representative. The Contractor shall establish the QA&QC laboratory at site and all field tests shall be done in the presence of the Engineer and / or his authorised representative. The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute such as CSMRS, NCBM, IITs, National Test House, Kolkata etc. as agreed by the Engineer. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by FQA representative of the engineer. The cost of transportation and other associative cost including the test charges shall be borne by the contractor. These cost shall deemed to be included in the respective item of work in the contract. If the Engineer desires to witness such tests at laboratory, Contractor shall arrange to conduct the test in his presence.

1.5.0 The recommendations and suitability of material for concreting and other building materials like brick, cement, aggregates etc., shall be ascertained by contractor prior to start of work.

Preliminary evaluation of aggregate and its evaluation for potential alkali-aggregate reactivity as per following scope of work shall be done:-

A. Evaluation of Aggregates:

I. To carry out different tests on coarse aggregate sample i.e. specific gravity,

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| | water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386.<br>II. To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis soundness, deleterious material, silt content, clay content and organic impurities as per IS: 2386.<br>III. To prepare evaluation report based on test results of I) and ii) above and to advise regarding suitability of fine and coarse aggregates.<br>B. <u>Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:</u><br>Evaluation for Potential Alkali-Aggregate reactivity as per following scope of work:<br>I. To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test.<br>II. To prepare a report based on test results of I) above and to advise regarding suitability of aggregates and further testing required if any.<br>The contractor shall initiate the action with regard to the above mentioned evaluation of aggregates and other building material, so as to ensure timely completion of these tests thereby not affecting any project work. All records shall be submitted, unless specified otherwise, as per the format developed by the Contractor and approved by the Engineer. |
| 1.6.0 | The Contractor shall enclose a comprehensive list of bought out items (BOIs) envisaged in the contract for carrying out fabrication/ manufacturing/ erection/ construction/ commissioning activities, procurement of forged, cast, semi-finished and finished components/equipment etc and shall indicate the names of reputed manufacturers for each of them in their bid proposal. The items envisaged by the Contractor to be procured from these manufacturers shall meet the specification requirement. An indicative list of major bought out items (not exhaustive) for civil works is enclosed at **Annexure-I**, for which the contractor shall submit the requisite details / lists of manufacturer's in their bid proposal. |
| 1.7.0 | The list of manufacturers / sub-vendors of each of the BOIs identified / indicated by the Contractor shall be discussed / reviewed by the NTPC during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOI shall be agreed/ approved. The list of manufacturers for all the BOIs envisaged in contract shall be included in the bid proposal and the same shall be discussed for finalization during the post bid discussions before placement of award. Where the manufacturers are placed in "DR" (Details required) category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the NTPC for approval within the period agreed at the time of post bid discussions. The Contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-Contractor detail submission / approval shall be furnished on format no. QS-01-QAI-P-02/F1. The NTPC shall furnish other relevant formats for information/ clarification for manufacturers / sub-vendors approval to the Contractor at the time of post bid discussions (Main supplier's evaluation report Format No: |

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| | QA-01-QAI-P-04/F1-R0 and Sub supplier questionnaire Format no: QA-01-QAI-P-04/F2-R0). Such manufacturers / sub-vendors approval shall not relieve the Contractor from any obligation, duty or responsibility under the contract. |
| 1.8.0 | Structural steel and Reinforcement steel supply if in the scope of the contractor shall be procured from Main Steel Producers enlisted by NTPC from time to time. Currently, Main Steel Producers enlisted by NTPC are SAIL, JSW Steel Ltd, Jindal Steel & Power, Tata steel Ltd. (for Reinforcement steel/TMT bars), RINL (for long products/Rolled sections and Reinforcement steel/TMT bars), Essar Steel India Ltd. (for Flat products/ Steel Plates), Electosteel steel Ltd. (for Reinforcement steel/TMT bars) and Monnet Ispat and Energy Ltd. (for long products/Rolled sections and Reinforcement steel/TMT bars). Subsequent, if any new Main Steel Producer/s are enlisted, they may also be considered for procurement during execution of the contract if proposed by the Contractor. |
| 1.9.0 | The Field Quality Plans shall detail out all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.<br><br>The contractor shall furnish complete QA & QC programme (QAP) for the work envisaged which may include the following:-<br>• The organisation structure for the management and implementation of the proposed Quality Assurance Programme.<br>• Documentation Control System<br>• The procedure for procurement of materials and source inspection.<br>• System for site controls including process controls.<br>• Control of non-conforming items and systems for corrective action<br>• Inspection and test procedures for site activities<br>• System for indication and appraisal of inspection status<br>• System for maintenance of records<br>• System for handling, storage and delivery.<br>• Quality Plan detailing out quality practices and procedures, relevant standards and acceptance levels for all types of work under the scope of this contract.<br><br>The Contractor shall appoint a dedicated, experienced and competent quality management representative on site, preferably directly reporting to the Project Manager, supported by experienced personnel, to ensure the effective implementation of the approved quality assurance programme.<br><br>The onsite quality management representative shall have the organisational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints.<br><br>The QA & QC setup of the contractor shall consist of qualified and experienced engineers, with their supporting staff. The QA&QC set up in addition to requisite mechanical & electrical engineers shall consist sufficient graduate civil engineers & supervisors to take care of quality assurance activities of both site & laboratory. An |

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| | indicative QA & QC organization chart is attached at **Annexure-III**. The deployment of man power for QA & QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the Engineer-in-charge for acceptance.<br><br>Based on the schedule of work agreed with the Engineer-in-charge and the approved FQP, the Contractor shall prepare a schedule of tests and submit them to the Engineer-in-charge and organise to carry out the tests as scheduled/ agreed.<br><br>The QA&QC laboratory shall have all necessary equipment, instruments and shall be managed by a qualified / experienced person. An indicative list of test equipment is attached at **Annexure-II**. All these testing equipment shall be provided by the contractor at his own cost. The contractor shall maintain the equipment in good working condition along with valid calibration certificates, for the duration of the contract. Any other equipment though required for testing but not listed in the equipment list shall be provided / arranged by the contractor at his own cost.<br><br>QA&QC laboratory building shall be constructed by the Contractor at their own cost. The laboratory building shall be constructed and installed with the appropriate facilities. Temperature and humidity controls shall be available wherever necessary during testing of samples. |
| 1.10.0 | The contractor shall prepare and obtain approval of the Owner of the Field Quality Plan (FQP) well before the start of the work. This FQP shall cover for all the items / activities covered in the contract/schedule of items and required for completion of the work. |
| 1.11.0 | All materials / components and equipment covered under the scope of work which are to be manufactured at shop/ factory of the vendor/subvendor shall be covered under a comprehensive quality assurance programme. The detailed quality plan for manufacturing shall be drawn up by the contractor and will be submitted to the owner for approval in the prescribed format for manufacturing quality plan.<br><br>Manufacturing Quality Plan (MQP) shall detail out all the components and equipment, various test/inspection, to be carried out as per the requirements of this specification and standards mentioned therein. The quality practices and procedures followed by Bidder's/Sub-Bidder's/ sub-supplier's Quality Control Organization shall include , the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of material procurement, manufacture, assembly and final testing / performance testing . The quality plan shall be submitted in electronic media e.g. CD or E-mail in addition to hard copy, for review and approval. After approval the same shall be finally submitted in compiled form on CD. |
| 1.12.0 | The contractor shall store and handle the materials as per the requirements of the relevant standards at his own cost. |
| 1.13.0 | All the equipment shall be duly calibrated by NABL/ NPL accredited laboratories/accreditation agencies. |
| 1.14.0 | The Contractor shall submit to the NTPC Field Welding Schedule for field welding activities in the format No.: QS-01-CQA-W11/F1, this format shall be furnished to the Contractor at pre-award stage. The field-welding schedule shall be submitted |

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| | to the NTPC along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. The Contractor shall submit Welding Procedure Specification (WPS) in the format No: QS-01-QAI-W-06/F1 for NTPC approval/ acceptance, this format shall be furnished to the Contractor during post bid discussion stage.<br><br>All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC.<br><br>All welding/brazing procedures shall be submitted to the NTPC or its authorized representative for approval prior to carrying out the welding/brazing.<br><br>All brazers, welders and welding operators employed on any part of the contract either in the Contractor's/ sub-Contractor's works or at site or elsewhere shall be qualified as per AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC.<br><br>Welding procedure qualification and Welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, tests shall be conducted in presence of NTPC/authorized representative.<br><br>No welding shall be carried out on cast iron components for repair.<br><br>All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.<br><br>All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification; The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC. |
| 1.15.0 | The Contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (Man-In-Charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the Contractor.<br><br>The Contractor shall install and operate equipments (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with |

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the Technical Specification requirements in association with the specialized blasting agency.

The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services/ work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site.

1.16.0 **ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME:**

i. Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1
ii. Indicative list of Field Quality Laboratory and Survey equipment list (Annexure-II)
iii. Indicative QA&QC Manpower requirements (Annexure-III)
iv. Indicative Field Quality Plan for Civil Works (Annexure-IV)
v. Indicative Field Quality Plan for Structural Steel Works (Annexure-V)
vi. Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R1
vii. Status of items requiring Quality Plan and sub supplier approval. Format No.: QS-01-QAI-P-02/F1-R0
viii. List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0
ix. Field Welding Schedule Format No.: QS-01-CQA-W-11/F1-R0
x. Welding Procedure Specification (WPS) Format No.: QS-01-QAI-W-06/F1-R0
xi. Main supplier's evaluation report Format No: QA-01-QAI-P-04/F1-R2
xii. Sub supplier questionnaire Format no: QA-01-QAI-P-04/F2-R1

(Note: The field quality plan attached is indicative and the contractor shall prepare the field Quality plan covering the entire scope of work in the contract and submit the same to corporate QA for acceptance/approval. However any addition or deletion in the scope of work, during detailed engineering shall be accordingly added/ deducted from the Field Quality Plan)

**2.0.0 GENERAL QA REQUIREMENTS**

2.1.0 **STORAGE AND HANDLING OF COMMON BUILDING MATERIALS**

All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in NTPC Technical Specification.

2.2.0 **EXCAVATION AND FILLING WORKS**

The contractor shall submit a work methodology covering various items of works for all stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading , compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance.

For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at

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site. The contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor.

Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the engineer. However, these tolerances shall be applicable for localized areas only.

Acceptance criteria shall be

a) When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation

b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation.

c) Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.

**2.3.0 MASONRY AND ALLIED WORKS**

The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable.

All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below:

| Sl. No. | Type of Check | Tolerance |
|---|---|---|
| | Deviation in verticality in total height of any wall of a building | Shall not exceed ± 12.5mm (more than one storey)<br>± 6mm per 3m height (within a storey) |
| | Deviation from the position shown on the plan of any brickwork | Shall not exceed 12.5mm (more than one storey) |

| | | |
|---|---|---|
| | Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment | Shall not exceed 6mm |
| | Deviation of bed joint from horizontal in any length, and it | Shall not exceed 6mm (upto 12m)<br>Shall not exceed 12.5mm total (in any length over 12m) |
| | Deviation from the specified thickness of bed-joints, cross-joints or perpends | Shall not exceed ± 3mm |
| | Finished plastered surface | Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface |
| | The average thickness of plaster | Not be less than the specified thickness |
| | The minimum thickness over any portion of the surface | Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster |

**2.4.0 CONCRETE WORKS**

For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement, compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance.

The equipment, deployment of manpower and machinery shall arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works.

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of engineer-in-charge.

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Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars.

Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494.

All the materials, equipments, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete.

If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45µ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production.

The acceptance criteria of concrete shall be in accordance with clause no.16 of IS 456. However in exceptional circumstances and that too in non-critical areas, the engineer may accept concrete work which is marginally unacceptable as per the criteria laid down in IS 456. For such accepted work, payment shall be made at a reduced rate pro rata to the concrete cube strength obtained, against that stipulated.

All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference.

i. Testing data / report of aggregates including petrographic examination & potential reactivity of aggregate and repeated temperature cycle tests wherever specified
ii. Mix design details and record of trial mixes carried out at site
iii. Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports.
iv. Approved scheme for concreting
v. Hourly records of concreting including pour card
vi. Protocol indicating the dimensional tolerance and details of inserts
vii. Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used
viii. Bar bending schedule
ix. Location and details of mechanical anchoring used for reinforcement
x. Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings
xi. Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification
xii. Temperature control record of concrete at the time of placement if applicable.

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xiii. Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations

xiv. Batching Plant shall be calibrated regularly at least once in a 3 months. Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used. Production and supply of concrete from batching plant shall conform to the provisions of IS 4926

xv. Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per NTPC Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 1% up to 1000 nos., @0.5% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456 and relevant IS code.

| **TOLERANCES** | | | | |
|---|---|---|---|---|
| **Description of Item/ Structural Element** | | | **Max (mm)** | **Min (mm)** |
| **Cast In Situ Concrete** | | | | |
| 1. | Faces of concrete in foundations and structural members against which back fill is placed | | +25 | -10 |
| 2. | Eccentricity of footing as percentage of footing width in the direction of placement | | 2% but limited to 50mm | |
| 3. | Top surfaces of slabs and of concrete to receive base plates to be grouted | | +5 | -5 |
| 4. | Alignment of beams, lintels, columns, walls, slabs and similar structural elements | | +5 | -5 |
| 5. | Cross sectional dimensions of walls, slabs and similar structural elements | | +5 | -5 |
| 6. | Deviation from specified dimensions of cross-section of columns and beams | | +12 | -6 |
| 7. | Alignment of holding down bolts without sleeves | | +1.5 | -1.5 |
| 8. | Alignment of holding down bolts with sleeves | | +5 | -5 |
| 9. | Level of holding down bolt assemblies | | +10 | -10 |
| 10. | Embedded Parts (in any direction). | | +5 | -5 |
| 11. | Level of embedment for equipment support | | +1.5 | 0 |
| 12. | Level of embedment for other embedded parts | | +5 | -5 |
| 13. | Centers of pockets or holes with greatest lateral dimension not exceeding 150mm | | +10 | -10 |
| 14. | Variation in steps<br>• Riser<br>• Tread | | <br>+1.5<br>+3.0 | <br>-1.5<br>-3.0 |
| **Pre- Cast Concrete** | | | | |
| 15. | Length: | +/- 0.1 percent | +/- 5 | + 10 |
| 16. | Straightness or Bow | 1/750 of the length | +/- 5 | +/- 10 |
| 17. | Cross-sectional dimensions | +/- 3 mm or +/- 0.1 percent whichever is greater | | |
| 18. | Squareness: | When considering the squareness of the corner the length of the two adjacent sides being checked shall be | | |

| TOLERANCES | | | | |
|---|---|---|---|---|
| **Description of Item/ Structural Element** | | | **Max (mm)** | **Min (mm)** |
| | | taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm. | | |
| 19. | Flatness: | The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm. | | |
| | **Placing of reinforcement and for cover (Cover blocks shall be of same grade of concrete in which these would be embedded)** | | Clause 12.3.1 and 12.3.2 of IS 456 | |
| | **Formwork** | | Clause 9.6 of IS 14687 and 11.1 of IS 456 | |
| | **Batching** | | Clause 10.2.2 of IS 456 | |

**2.5.0 STRUCTURAL STEEL WORK**

For structural steel works provisions of technical specifications and IS: 800 shall apply. A detailed methodology for structural steel works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The contractor shall submit the welding procedures specification (WPS), heat treatment procedures, NDT procedures etc. at least ninety days before scheduled start of erection work at site. All welding and brazing shall be submitted to the NTPC and carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC.

All brazers, welders and welding operators employed on any part of the contract either in the contractor's / sub-contractor's works or at site or elsewhere shall be qualified as per AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC.

The records of welding procedure qualification and welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, the tests shall be conducted in presence of NTPC / authorized representative.

No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test

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report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC.

Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specification / approved WPS.

The requirements of pre-heating shall be

| Thickness of thickest part at the area of welding / heat affected zone | Welding using other than low hydrogen welding electrodes IS 2062 | Welding using low hydrogen welding electrodes or submerged arc welding IS 2062 |
|---|---|---|
| Upto 20 mm (including) | None | None |
| Over 20 mm to 40 mm (including) | Not allowed | 200 C |
| Over 40 mm to 63 mm (including) | Not allowed | 660 C |
| Over 63 mm | Not allowed | 1100 C |

The following tests / checks shall be carried out for structural steel works

| SL. NO. | TESTS / CHECKS | QUANTUM / STANDARD |
|---|---|---|
| | Physical and chemical properties of material if supply in the scope of contractor | As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC |
| | Ultrasonic test on plates above 40mm | As per ASTM A435 |
| | Welding procedure & welders qualification test | AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards |
| Fillet Weld | | |
| | Macro-etch examination on production test coupons for main fillet welds | Minimum one joint per built up beams, columns and crane girder etc. |
| | Tension member of crane girder | Dye penetration test on 25% weld length |
| | All other fillet welds | DPT on 5% of weld length with minimum 300mm at each location |
| Butt Weld | | |
| | DPT | 100% after back gouging on all butt welds |
| | Mechanical testing of production test coupons | Minimum one joint per built up beam, column and crane girder. |
| | Radiography test on butt welds<br>(In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.<br>Wherever RT is not feasible UT to be carried out with the approval of the | 100% RT on butt welds of tension flange (bottom flange) of crane girders<br>10% RT weld length of each welder on butt welds, |

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| SL. NO. | TESTS / CHECKS | QUANTUM / STANDARD |
|---|---|---|
| | engineer) | |
| | Ultrasonic testing on full penetration welds (other than butt welds) | 100% UT on the web to flange joint of crane girder<br>10% UT on other full penetration joints |
| | Control assembly check in shop before erection | 1st and further every 10th set of identical structure |
| | Dimensional tolerances during fabrication and erection | as per IS-7215 and IS-12843 |
| | Surface Preparation and Paint thickness | SA 2 1/2 , By elcometer random after each coat, each member |

**2.6.0 PAINTING WORKS**

Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for painting works shall broadly contain the source of approved brand of paints, shot / sand blasting as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance.

**2.7.0 SHEETING WORKS**

All bought out items shall be procured from the manufacturer's approved by engineer and tested as per relevant IS Codes/ Specification. Raw material of colour coated sheets shall meet the chemical & physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for colour match, bare metal thickness, weight of Z/AZ coating, thickness of painting system, reverse impact, T-Bend adhesion, scratch resistance, salt spray test for 1000 Hrs and any other test / properties as specified in the technical specifications. Colour coated sheets shall be marked with video jet printing at the interval not more than 2m bearing manufacturer's name, date and time of manufacturing. Fasteners shall also be tested for 1000 hrs salt spray test as per the requirement of technical specifications.

Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183.

For sheet installation no gas cut opening shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion.

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| **2.8.0** | **TILE WORKS**<br><br>The contractor shall submit the work methodology which shall include the type, grade and make of materials along with their technical data sheets, details, etc, clearance from E-I-C regarding leak proofness and damp proofness of parent concrete surface, surface preparation, the procedure of application, curing, testing and acceptance.<br><br>The agencies having adequate experience to execute the acid / alkali resistant lining works shall be engaged for executing the acid / alkali resistant lining works after obtaining the approval from the E-I-C.<br><br>The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the NTPC approved brand / source. Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable.<br><br>The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832, part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness. |
| **2.9.0** | **FIRE PROOF DOORS**<br><br>Fire Proof doors shall be tested for the requirements mentioned in the Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system |
| **2.10.0** | **WATER PROOFING**<br><br>The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the NTPC approved brand / source and the works shall be executed by the authorized applicator of the supplier.<br><br>Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel / drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course. |
| **2.11.0** | **PILING WORK (If Applicable)**<br><br>For piling works provisions of technical specifications, approved drawings, BOQs and relevant IS codes / standards shall apply. The piling works shall be executed by the agency meeting the qualifying requirements as specified. A detailed |

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methodology for piling works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for piling works shall broadly contain the method of boring, stability of bore hole, termination criteria, tests / checks for termination level, fabrication of cage, cage lowering, concrete batching / mixing, transportation, placing, recording of the time of construction operations, method of conducting initial and routine load tests, testing and sampling of concrete during production and placement and acceptance checks on piles for final clearance.

The equipment, deployment of manpower and machinery shall be arranged by the contractor to prevent the collapse of bore hole and to ensure continuous rate of placement of specified grade of concrete.

The piling works shall be executed as per the technical specifications, approved drawings, relevant codes / standards, FQP and BOQ. In addition to the requirements of technical specifications, the following shall also be ensured while execution of piling works:

a) Time gap between completion of pile boring and start of concreting should be kept to the minimum. However the maximum time gap shall not be more than 6 hours.

b) Muck Debris should be removed from the pile bore by air lift technique(by keeping the tremie & air pipe as close as to bottom of pile bore) i.e. after completion of boring, after completion of SPT(wherever applicable), after lowering reinforcement cage, but before start of concreting.

c) Density of bentonite slurry shall be checked from the sample taken from the bottom of pile bore( not at 1.0 m above the bottom of the pile bore)

d) Minimum two welding sets shall be kept ready to join the two cages of reinforcement by engaging 3 or more welders. This will ensure the lowering of R/F cage in minimum time.

e) While lowering the R/F cage into the pile bore, two hooks shall always be used to ensure balanced/symmetrical insertion of cage into the pile bore.

f) Concrete cover blocks at the junction of two R/F cage shall be ensured before lowering the second segment.

g) Surge concreting of about 1.0 cum shall be ensured at the start of concreting (i.e. in the first pour), by suddenly allowing to fall through the tremie pipe from the funnel. This will help in displacing left out muck/debris in the pile bore (by the impact).

h) Continuous feeding of concrete shall be ensured by deploying at least two transit concrete mixers (if required to be deployed) and mixing done through concrete batching plant (if deployed). Cold joints in the pile shall be avoided.

i) In a pile group, SPT shall be carried out at termination level in the pile, taken up first.

j) Bentonite slurry circulation to be ensured from start of boring to start of concreting. Flushing of bentonite slurry will only ensure maintaining of density of bentonite slurry uniformly and will not allow bentonite jelly to settle at the bottom, whereas air lift technique with bentonite circulation will ensure removal of muck debris from the bottom of pile bore.

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k) Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, minimum once per week or as found necessary by the engineer. One sample consisting of 3 specimens shall be tested for the above.

l) Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Technical Specification. This test shall be suitably used to identify the piles for routine tests. High Strain dynamic test shall be done as per the technical specification. The frequency of the test shall be as per the BOQ

m) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength

**PILE LOAD TEST**

Pile load testing shall conform to the requirements of IS-2911 (Part IV) and the technical specification. Initial load tests as specified in the contract documents shall be conducted to assess the safe load carrying capacity of pile before start of work. To verify the load carrying capacity of the working piles, routine load test shall be conducted.

Pile load-testing procedure and the test setup / scheme shall be submitted for approval of NTPC. The contractor shall use the test setup having arrangement for anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge for both vertical compression and uplift (tension) Load test (initial) on piles. The cost of reaction system / piles shall deem to be included in the cost of test piles

All the gauges and instruments shall be calibrated before the start of the tests on test piles and working piles and the calibration record shall be verified before start of execution of the test.

**2.12.0 WATER SUPPLY, DRAINAGE & SANITATION**

Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in NTPC technical specification.

The obstructions in sewer lines shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight.

The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under test / working condition of pressure and flow, when all draw-off taps

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| | are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost. |
| **2.13.0** | **ARCHITECTURAL & MISC. WORKS** |
| | Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in NTPC technical specification. |
| | Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm. |
| | Materials used in glass and glazing shall be procured from source approved by NTPC and shall conform to the requirements of the Technical Specification and IS Codes. |
| | False ceiling panels shall be best quality material in thickness and properties called for in the specification / schedule of items. Material Test Certificate to be submitted before bulk supply. |
| | All bought items covered in the scope of contract shall be procured from sources approved by NTPC and shall conform to the requirements of the technical specifications and referred standards /codes. |
| **2.14.0** | **PRE CAST CONCRETE WORKS** |
| | 1. All the materials used in Pre cast Concrete work shall be tested and conform to the requirements of IS codes and NTPC Tech. Specification.<br>2. Concrete mix for Pre cast members shall conform to IS-456-2000.<br>3. All relevant QA requirements pertaining to cast insitu concrete shall be applicable.<br>4. Pre Cast Concrete member shall be checked for dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances shall be as per NTPC Technical Specification. |
| **2.15.0** | **FABRIC EXPANSION COMPENSATOR:** |
| | Each layer of fabric Compensator shall be checked for thickness, unit weight, tensile strength & elongation, composite layer of the expansion joint shall be tested for temperature withstandability test. |
| | Thermal Insulation shall be checked for thickness, density, thermal conductivity test and all other tests as per IS:8183. |
| | Tests and checks on all other items shall be carried out as per relevant codes. |

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| **2.16.0** | **SLIPFORM SHUTTERING**<br><br>1. The monitoring of the leveling of the yoke and the platform of the slip form shuttering to be done in each shift to avoid tilt during the casting of the chimney shell.<br><br>2. Manning of each shift shall be done by at least two experienced operators and a foreman particularly in night shift.<br><br>3. Suitable removal/ reduction of overhung / excess yoke beam length shall be affected with the decrease in the diameter of Chimney shell, as per the approved plan.<br><br>4. The laser centering method to be deployed for chimney alignment and Monitoring of chimney centre should be done by laser instruments at least two points. Monitoring/Recording of the same shall be done in each shift of 8 hours<br><br>5. Shuttering plates to be used for slip form shall be new and the grade of steel shall conform to the specification requirements.<br><br>6. The outage of the alignment of chimney centre shall be prevented by creating a counterbalance for alignment purpose to avoid differential loading, arising out of placement of reinforcement bars at one side or unloading of concrete in a hopper at one side of the platform for slip form shuttering. |

ANNEXURE -I

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| एनटीपीसी NTPC | PROJECT: | LIST AND STATUS OF ITEM REQUIRING QP AND SUB-SUPPLIER APPROVAL | | | | NTPC DOC NO | |
| | PACKAGE: FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | | | REV. NO. | 0 |
| | MAIN SUPPLIER: | | | | | DATE | |
| | CONTRACT NO.: | | | | | | |
| **SR. NO.** | **ITEM** | **QAP / INSP. CAT** | **QAP NO.** | **PROPOSED SUB SUPPLIER** | **PLACE OF MANUFACTURING** | **APPROVAL STATUS** | **REMARKS** |
| | | | | | | | |
| 1 | CEMENT | | | | | | |
| 2 | CONSTRUCTION CHEMICALS - ADMIXTURES, PLASTISIZERS, RETARDERS, WATER PROOFING COMPOUNDS, GROUTS, RESINS, EPOXY ETC. | | | | | | |
| 3 | COLOUR COATED SHEET(FOR COIL) | | | | | | |
| 4 | PROFILERS FOR DECKING/CLADDING SHEETS | | | | | | |
| 5 | ELECTROFORGED GRATING | | | | | | |
| 6 | PAINT AND PAINTING SYSTEM | | | | | | |
| 7 | GI PIPES | | | | | | |
| 8 | INSULATION WOOL | | | | | | |
| 10 | PVC WATER STOP | | | | | | |
| 11 | PLASTIC/ PVC PIPES | | | | | | |
| 12 | FLOOR TILES | | | | | | |
| 13 | FIRE PROOF DOORS | | | | | | |
| 14 | PARTICLE BOARDS, PLYWOOD, MDF | | | | | | |
| 15 | ROOF WATER PROOFING | | | | | | |
| 16 | RCC PIPES | | | | | | |
| 17 | FALSE CEILING - GLASS REINFORCED GYPSUM | | | | | | |
| 18 | BITUMEN ASPHALT | | | | | | |
| 19 | BITUMEN IMPREGNATED FIBER BOARD JOINT | | | | | | |
| 20 | SANITARY ITEMS | | | | | | |
| 21 | CP BRASS TAP AND OTHER SANITARY FITTINGS | | | | | | |
| 22 | POLYTHENE WATER STORAGE TANKS - IS 12701 | | | | | | |
| 23 | CHIMNEY ELEVATOR | | | | | | |
| 24 | PTFE BEARING / ELASTOMERIC BEARING | | | | | | |
| 25 | FOUNDATION BOLTS | | | | | | |

LEGENDS:

1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list along with the condition of approval, if any.

DR – For these items “Details required” for NTPC review. To be identified with letter “DR” in the list.

'N' NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with ‘NOTED.’

2. QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved

CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.

UNITS/ WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

**NOTE: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by NTPC-EIC/ FQA on the basis of certificate of conformance submitted by the main supplier/ main contractor.**

| Clause No | QUALITY ASSURANCE PROGRAMME |
|---|---|

**Annexure – II**

## INDICATIVE FIELD QA&QC LABORATORY SET-UP

| S.No | Equipment | Nos. |
|---|---|---|
| 1 | Vicat Apparatus with deskpot | 2 |
| 2 | Le Chatelier flask | 2 |
| 3 | Le Chatelier Mould | 2 |
| 4 | Cube Moulds for cement testing | 12 |
| 5 | Vibration Machine | 1 |
| 6 | Length comparator | 2 |
| 7 | Shrinkage Bar mould | 2 |
| 8 | Sieve shaker | 1 |
| 9 | Sieves for sand, coarse & fine aggregate | 1 set for each |
| 10 | Sieves for coarse aggregate for Road | 1 set |
| 11 | Proctor testing equipment | 2 sets + 18 cores |
| 12 | Slump testing equipment | 6 sets |
| 13 | Oven | 2 |
| 14 | Physical balance | 1 |
| 15 | Rapid moisture meter | 2 |
| 16 | Thermometer | 4 |
| 17 | Burret | 2 |
| 18 | Measuring cylinders | 9 |
| 19 | Measuring flasks | 3 |
| 20 | Compression testing machine | 2 sets |
| 21 | Cube moulds | 30 |
| 22 | Electronic balance | 2 (12 kg capacity), 2 ( 200 mg capacity) |
| 23 | pH balance | As per requirement |
| 24 | Radiographic facilities | As per requirement, Party should deploy BARC approved agency for carrying out RT |
| 25 | Mechanical weighing machine | 1 (100 kg capacity) |
| 26 | Ultrasonic testing machine | As per requirement |
| 27 | D.P. Test kit | 10 |
| 28 | Vernier 300 mm, 600 mm | 2 |
| 29 | Micrometer (0.25 mm) out side (25.00) | 2 |
| 30 | Radiography film viewer | 2 |
| 31 | Inside Micrometer 25-750 dia | 2 |
| 32 | Digital elcometer for paint thickness | 2 |
| 33 | Baking oven for electrode | 3 |
| 34 | Portable ovens | 2 |
| 35 | Rebar detector to locate the reinforcement before core cutting operation | 1 |
| 36 | Concrete coring machine (55mm, 60mm upto 150 mm dia core bit) | 1 |
| 37 | Rebound hammer | 1 |
| 38 | Ultrasonic pulse velocity tester | May be arranged from specialist laboratory. |

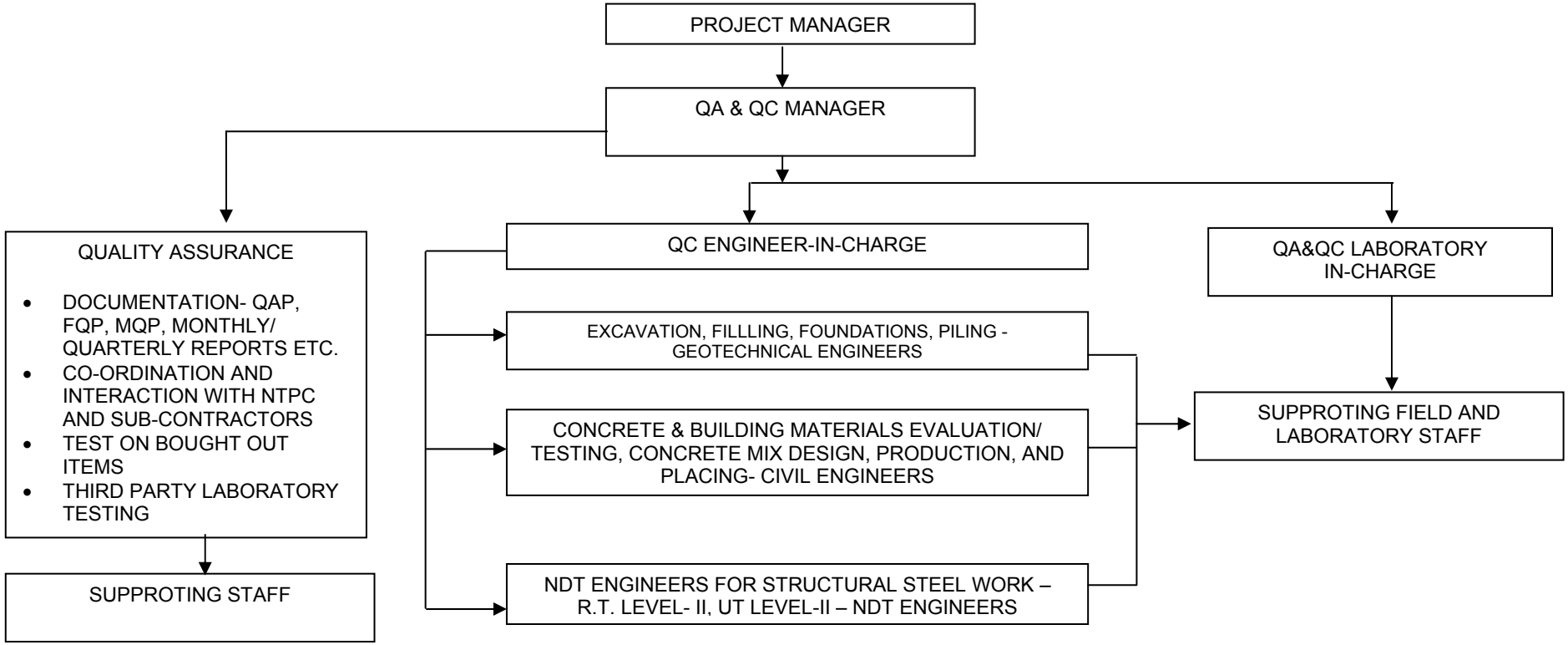
| Clause No | QUALITY ASSURANCE PROGRAMME |
|---|---|

Note :

1. The equipments listed above are indicative and required to be mobilised as minimum requirement. additional equipment if any ,required for successful completion of work shall be provided /arranged by the contractor.
2. All test reports/ inspection reports have to be computerized and maintained on LAN with an access to the owner
3. Computers - 2 Nos shall be deployed with Windows operating system and connected to the NTPC server
4. Based on the schedule (L2/L3 Network), Quality control & Quality Assurance work plan shall be finalized by the contractor and the same shall be submitted to the engineer-in-charge for acceptance/approval. The Finalized work plan shall be maintained on the computer to be accessed by the owner for database and day to day monitoring.

**Annexure – III**

***INDICATIVE FIELD QA & QC MANPOWER STRUCTURE***




**NOTE:**

1. The above organization setup is minimum, however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval.
2. The contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work.
3. The contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | 1<br>0 | | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| 1.00 | **GENERAL REQUIREMENTS** | | | | | | | | | | |
| A | Setting up of Field QA&QC laboratory | | As agreed / required | A | Physical | Once prior to start of work | Tech Specs and Const. Drawings | | SR | √ | Functioning of laboratory equipment in proper working condition to be verified on monthly basis |
| B | Avialablility of requisite laboratory set up and equipment in good working condition well before commencement of concerned activity | | As agreed / required | A | Physical | Once prior to start of work and thereof monthly | Tech Specs and Const. Drawings | | SR | √ | |
| C | Submission of QA & QC manpower deployment schedule based on agreed L-2 network . | | - | A | Physical | Once prior to start of work | Tech Specs and Const. Drawings | | | √ | |
| D | Availability of QA& QC manpower based on deployment schedule . | | - | A | Physical | Once prior to start of work and thereof monthly | Tech Specs and Const. Drawings | | SR | √ | |
| E | Sampling for testing of buliding materials, concrete mix design etc. | | As agreed / required | A | Physical | Once per each source prior to start of concern work | Tech Specs and Const. Drawings | | SR | √ | Test report along with the recommendations from specialist agency to be submitted to NTPC. |
| F | Submission of schedule of tests to be done monthly / quaterly and maintenace of the same on a computer connected to LAN of NTPC for monitoring | | - | A | Physical | Once prior to start of work and thereof monthly | Tech Specs and Const. Drawings | | SR | √ | |
| | | | | | | | | | | | |
| 2.00 | **EXCAVATION AND FILLING IN FOUNDATION WORKS** | | | | | | | | | | |
| | **Excavations-** | | | | | | | | | | |
| 1 | | Check for the Nature, type of soil/rock before and during excavations | As agreed / required | B | Visual | Random in eah shift | Tech Specs and Const. Drawings | | SR | | |
| 2 | | Check for the Initial ground level before start of excavations | As agreed / required | B | Measurement | 100% | Tech Specs and Const. Drawings | | SR | | |
| 3 | | Check for the final shape and Dimensions of excavations. | As agreed / required | B | Measurement | 100% | Tech Specs and Const. Drawings | | SR | | |
| 4 | | Check for the Final excavation lelvels | As agreed / required | B | Measuement | 100% | Tech Specs and Const. Drawings | | SR | | |
| 5 | | Check for the Side slope of final excavation | As agreed / required | B | Measurement | Random in eah shift | Tech Specs and Const. Drawings | | SR | | |
| 6 | | Excavation in Hard Rock. | | | | | | | | | |
| i | | Receipt, Storage, accountability of Explosive | As agreed / required | B | Physical | Random in each week | Indian Explosive Act 1940/all statutory norms, Tech Specs and Const. Drawings | | SR | √ | NTPC approved specialist blasting agency such as CMRI, NIRM shall be deployed at site for trial blasts, design blasts, blast vibration monitoring etc. Seismographs shall be deployed at site for monitoring of blast operation vibrations. |
| ii | | Execution of Blasting Operation | As agreed / required | B | Physical | Random in eah shift | IS:4081, Tech Specs and Const. Drawings | | SR | √ | |
| iii | | Submission of Blasting report to EIC | As agreed / required | C | Physical | Each blast | Tech Specs and Const. Drawings | | | √ | |
| 7 | | Excavation in Hard Rock (Blasting Prohibited) | As agreed / required | B | Physical | 100% | As per approved drawing/ scheme, Tech Specs and Const. Drawings | | SR | √ | |
| | **Fill/ Backfill -** | | | | | | | | | | |
| 8 | **Suitability of fill material** | | | | | | | | | | |
| i | | Grain size analysis | As required/ agreed | B | Physical | One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples | IS:2720 (Pt.IV), Tech Specs and Const. Drawings | | SR/TR | √ | |
| ii | | Liquid & plastic limit | As required/ agreed | B | Physical | One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples | IS:2720 (Pt.IV) , Tech Specs and Const. Drawings | | SR/TR | √ | |
| iii | | Shrinkage limit | As required/ agreed | B | Physical | One in every 5000 cum for each type and source of fill materials subject to a min. of 2 samples | IS:2720 (Pt.IV), Tech Specs and Const. Drawings | | SR/TR | √ | |
| iv | | Free Swell Index | As required/ agreed | B | Physical | One in every 5000 cum for each type and source of fill materials | IS:2720 (Pt.XI), Tech Specs and Const. Drawings | | SR/TR | √ | |
| 9 | **Standard proctor Test** | Optimum moisture content and max. dry density before fill | As required/ agreed | A | Physical | One in every 2000 cum for each type and source of fill materials | IS 2720 (Pt.VII), Tech Specs and Const. Drawings | | SR/TR | √ | |
| 10 | **Moisture content** | Moisture content of fill before compaction | As required/ agreed | A | Physical | One in every 2000 cum for each type and source of fill materials | IS 2720 (Pt.II), Tech Specs and Const. Drawings | | SR/TR | √ | |
| 11 | **Degree Of Compaction Of Fill / Backfill** | | | | | | | | | | |
| i | | Dry density by core cutter method<br>---- OR----<br>Dry density in place by sand displacement method | As required/ agreed | A | Physical | i) For foundation fill/ backfill one for every 10 foundations for each compacted layer. | IS 2720 (Pt. XXIX), Tech Specs and Const. Drawings | | SR/TR | √ | |
| | | | | | | ii) For area filling, one every 1000 SQM area for each compacted layer. | IS 2720 (Pt. XXVIII), Tech Specs and Const. Drawings | | SR/TR | √ | |
| ii | | Relative density (Density Index) | As required/ agreed | A | Physical | ----do----- (i) & (ii) above | IS 2720 (Pt. XIV), Tech Specs and Const. Drawings | | SR/TR | √ | |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | | 1<br>0 | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| iii | | Dry Density by proctor needle penetration | As required/ agreed | B | Physical | Random checks to be carried out for each compacted layer | Tech Specs and Const. Drawings | | SR/TR | √ | |
| 3.00 | **CAST-IN-SITU CONCRETE** | | | | | | | | | | |
| | **MATERIALS** | | | | | | | | | | |
| 1 | **Cement** | | | | | | | | | | |
| i | | Initial & Final Setting Time | as per IS:4031 | A | Physical | Each Lot | IS:4031 | As per relevant IS Codes | SR/LB/ Test Report | √ | Each consignment of cement shall be duly correlated with manufactureres TC, If cement is stored more than 90 days in godown of contractor same shall be retested for comp. Strength & setting time. |
| ii | | Compressive strength @ 3, 7 & 28 days | as per IS:4031 | A | Physical | Each Lot | IS:4031 | As per relevant IS Codes | SR/LB/ Test Report | √ | |
| 2 | **Coarse Aggregate** | | | | | | | | | | |
| i | | Moisture content | . | B | Physical | Once for each stack of 100 Cum. or part there of Except during monsoon when this has to be done every day before start of concreting | IS:2386 Part-III, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings | | SR/LB | | Accordingly water content of the concrete will be adjusted |
| ii | | Specific gravity, bulk density, voids, water absorption, | As required/ agreed | B | Physical | Once for each source & for every change of source | IS:2386 Part-III, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings | | SR/TR | | These tests will be carried out white establishing design mix and the results to be intimated to NTPC. |
| iii | | Particle, size & Shape-(Sieve analysis, determination of material finer than 75 micron, flakiness index, elongation index, angularity number) | As required/ agreed | B | Physical | One per 100 cum., or part thereof/change of source whichever is earlier | IS:2386 Part-I, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings | | SR/LB | | -do- |
| iv | | Deleterious materials & organic impurities (determination of clay lumps, fine silt, fine dust , light weight pieces , soft particle & estimation of organic impurities.) | As required/ agreed | B | Physical | Once per source/ on every change of source | IS:2386 Part-II, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings | | SR/TR | | Experts opinion regarding suitability of the aggregates shall be obtained from the specialist agency such as NCB BallbhGarh etc. finalised during preaward. Results will be reported nearest to 0.1% of clay lumps. |
| v | | Soundness | As required/ agreed | B | Physical | Once per source/ on every change of source | IS: 2386 Part-V, IS:383 , Tech Specs and Const. Drawings | | SR/TR | | Experts opinion regarding suitability of the aggregates shall be obtained from the specialist agency such as NCB BallbhGarh etc. finalised during preaward. |
| vi | | Alkali aggregate reactivity | As required/ agreed | A | Physical | Once per source/ on every change of source | ASTM C 1260 , Tech Specs and Const. Drawings | | SR/TR | √ | the quantity of dissolved silica , and reduction in alkalinity to be reported and hence the aggregate type (deleterious /innocuous)result should be supported by petrographic examination |
| vii | | Petrographic examination | As required/ agreed | A | Physical | Once per source/ on every change of source | IS: 2386 Part-VIII, IS:383 , Tech Specs and Const. Drawings | | SR/TR | √ | Reporting of petrographic examination shall be done as illustrated in IS 2386 ( part-VIII)-1963. petrographic report shall be supported by the analysis and recommendation by a specialist instute. |
| viii | | Crushing value abrasion value and impact value | As required/ agreed | A | Physical | Once per source/ on every change of source | IS:383, IS-2386 Part IV/, Tech Specs and Const. Drawings | | SR/TR | | -do- |
| 3 | **Fine Aggregate** | | | | | | | | | | |
| i | | Moisture content | As agreed / required | B | Physical | To be done every day before start of work | IS: 2386 Part-III IS:383 , Tech Specs and Const. Drawings | | SR/TR | | Weight of sand and weight of water shall be adjusted as per moisture content. |
| ii | | Silt, Clay content and organic impurities | As agreed / required | B | Physical | Once per source& for on every change of source | IS: 2386 Part-II, IS:383 , Tech Specs and Const. Drawings | | SR/TR | | Acceptance limit as per relevant IS code |
| iii | | All other tests similar to coarse aggregates as mentioned above. | As agreed / required | B | As above | Refer S.No. 2.01.02 | IS-2386, IS-383, Tech Specs and Const. Drawings | | SR/TR | | |
| 4 | **Water** | | | | | | | | | | |
| i | | Test for sulphates and chlorides | As required/ agreed | B | Testing | Once per each source thereof yearly. | IS:3025 part 22 and 23 (for test procedure ), IS:456(for acceptance criteria ) , Tech Specs and | | SR/TR | | |
| ii | | Tests for ascertaining limit of solids | As required/ agreed | B | Physical | Once per each source thereof yearly. | IS:3025 part 18 (organic),IS:456 , Tech Specs and Const. Drawings | | SR/TR | | |
| iii | | Tests for pH Value | As required/ agreed | B | Testing | Once per each source thereof yearly. | IS:3025, IS:456, Tech Specs and Const. Drawings | | SR/TR | | |
| iv | Check for initial set time for used water and distilled water | vicat appratus | | A | Physical | See Remarks | See Remarks, Tech Specs and Const. Drawings | | See Remarks | √ | Initial set time with used water should not be less than that with distilled water. This check is to be carried out only if the results of the tests mentioned at sl. no. 3.00, .4 i),ii)& iii) mentioned above |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | | 1<br>0 | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| v | Check for Concrete compressive strength with used water and distilled water | standard sand and compression testing machine | As agreed / required | A | Physical | See Remarks | See Remarks, Tech Specs and Const. Drawings | | See Remarks | √ | This check is to be carried out only if the results of the tests mentioned at sl. no. 3.00, .4 i),ii)& iii) mentioned above |
| 5 | CONCRETE PRODUCTION | | | | | | | | | | |
| i | | Check for the proportaions of materials for nominal mix concrete as per Table-9 of IS 456 | As agreed / required | B | Physical | Random in each shift | IS:456, Tech Specs and Const. Drawings | | SR/TR | | |
| ii | | Trial mix (Cubes compressive strength) as per Mix Design | As agreed / required | A | Physical | Min. 4 Trial Mixes with admixtures and Without admixtures With fly ash. | IS: 516 & IS:456, IS:10262, Tech Specs and Const. Drawings | | SR/TR | √ | For trial mix min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength. Mix design shall carried out at agency finalised during pre award ) |
| iii | | Crushing strength (works Tests cubes) | As agreed / required | A | Physical | One set of 6 cubes per 50 M3 or part thereof for each grade of concrete per shift whichever is earlier. | IS:516, IS:456, Tech Specs and Const. Drawings | | SR/TR | √ | Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength. |
| iv | | Workability - slump test | As required/ agreed | B | Physical | One sample every 2 hrs. from every mixing plant | IS:456, Tech Specs and Const. Drawings | | SR/TR | | Slump test for medium and high workability, Compaction factor test for medium and low workability, V.B. test for low to Very low workability |
| v | | Cement content | As agreed / required | B | Physical | At random at the time of batching. | IS:1199 , Tech Specs and Const. Drawings | | SR/TR | | |
| vi | | Admixtures for Concrete from approved sources | As agreed / required | A | Review of MTC | Random in each shift | IS:456 , Tech Specs and Const. Drawings | | SR/TR | √ | Admixture of appd. Brand and tested quality shall be used. |
| vii | | Water Tightness Test for Water Retaining Structures | As agreed / required | B | Physical | 100% | IS:3370 (Tanks and Revision) , Tech Specs and Const. Drawings | | SR | √ | |
| viii | | Dimensions and visual exa-mination of finished structure | As agreed / required | B | Physical/ visual | 100% | As per Tech. Specification./Appd. Drg./IS-456 | | SR | | |
| 6 | CONCRETE CONVEYING, PLACING& COMPACTION | | | | | | | | | | |
| i | Mixing of concrete | mixing of concrete shall be done in a approved mixer such as to produce a homogenous mix | As required/ agreed | | | To be calibrated at the time of starting and subsequently once in three months, and shall confirm to IS:4925 | Review of calibration chart/ Certificate, IS 457, Tech Specs and Const. Drawings | | | | time of mixing will be as given in IS 457 |
| ii | | Calibration of Batching Plant | As required/ agreed | A | Physical | To be calibrated at the time of starting and subsequently once in three months, and shall confirm to IS:4925 | Review of calibration chart/ Certificate, Tech Specs and Const. Drawings | | SR/TR | √ | Cement consumption at batching plant shall also be obtained through comp. Output.Provision of online printer is manadatory |
| iii | | Handling and Transportation of concrete | As required/ agreed | B | Physical | Random in each shift | IS:456, Tech Specs and Const. Drawings | | SR | | Free fall or drop shall be limited to 150 cm unless permitted concrete should be placed within 30 min of its removal from mixure . Construction methodology to be approved one week prior to start of work. |
| iv | | Placement of concrete | As required/ agreed | B | Physical | Random in each shift | IS:456, Tech Specs and Const. Drawings | | SR | | No concrete shall be placed until the place of deposit has been throughly inspected and approved, the concrete shall be deposited in such a manner to maintain, until completion of unit, a plastic horizontal surface throughout |
| v | | Check for compaction and Curing | As required/ agreed | B | Physical | Random in each shift | Check for period of curing as per IS 456 , Tech Specs and Const. Drawings | | SR | | Exposed concrete surface shall be protected against heating and drying for atleast 72 hrs after placement, curing compound may be used |
| vi | | Cleanliness, provision of chute and arrangement for transportation & placement of concrete. | As agreed / required | C | Visual | 100% | IS:456, Tech Specs and Const. Drawings | | SR | | |
| x | | check for segregation | As agreed / required | C | Visual | 100% | IS:456, Tech Specs and Const. Drawings | | | | |
| 7 | TEST/CHECK ON RCC STRUCTURE IN HARDENDED CONDITIONS | | | | | | | | | | |
| i | | Core Test | As agreed / required | A | Physical | As required by NTPC Engineer. | As per IS:456, IS 516, Tech Specs and Const. Drawings | | SR/LB/ Test Report | √ | Acceptable if average equivalent cube strength of the cores is equal to at least 85% of the cube strength of the grade of concrete specified for the corresponding age and no indivisual conc has result less than 75%` |
| ii | | Dimensional check on finished structures & Dimensional tolerances | As agreed / required | B | Measurement | Approved Drawing | As per IS:456, Tech Specs and Const. Drawings | | SR/LB | | |
| iii | | Rebound Hammer test | As agreed / required | A | physical | As required by the NTPC engineer | Tech Specs and Const. Drawings | | SR/LB | √ | |
| 8 | REINFORCEMENT STEEL | | | | | | | | | | |
| i | | Physical and Chemical Properties for each lot as per relevant IS codes | As required/ agreed | A | Review of MTC | Each batch of delivery | IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings | | MTC | √ | Applicable if steel is procured by Contractor |
| ii | | Cutting tolerance | As agreed / required | B | Measurement | Random in each shift | IS : 1852, IS: 432, IS:1786, Tech Specs and Const. Drawings | | SR/LB | | Tolerance as per specifications |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | | 1<br>0 | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | D* | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | | 10 |
| iii | | Freedom form cracks surface flaws, Lamination. | As agreed / required | B | Visual | Random in each shift | IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings | | SR/LB | | To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs. |
| 9 | PLACEMENT OF REINFORCEMENT STEEL | | | | | | | | | | |
| I | | Check for bar bending schedule with necessary laps. Spacers & Chairs | As agreed / required | B | Visual & Measurement | Random in each shift | Approved Drawings, Tech Specs and Const. Drawings | | SR | | |
| ii | | Check for cover, spacing of bars | As agreed / required | B | Visual & Measurement | Random in each shift | Approved Drawings, Tech Specs and Const. Drawings | | SR | | |
| iii | | Check for bending of bars | As agreed / required | B | Visual & Measurement | Random in each shift | Approved Drawings, Tech Specs and Const. Drawings | | SR | | |
| iv | | Check for spacers and chairs after the reinforcement cage is put inside the formwork | As agreed / required | B | Visual & Measurement | Random in each shift | Approved Drawings, Tech Specs and Const. Drawings | | SR | | |
| v | | Acceptance of placement od reinforcement before start of concreting | As agreed / required | B | Visual & Measurement | beofre start of each concreting | IS : 456/ Drawings & approved bar bending, Tech Specs and Const. Drawings schedule | | SR | | |
| 10 | STAGING AND FORMS | | | | | | | | | | |
| i | | Materials and accessories | As agreed / required | B | Visual | Once before start of work | As per relevant IS, Tech Specs and Const. Drawings | | SR | | Proper care should be taken in order to combat corrosion. Proper care should be taken while cleaning, moving and stacking the scaffolds |
| ii | | Soundness of staging, shuttering and scaffolding | As agreed / required | B | Visual | Once before start of work | As per manufacturer's spec.and as per 3696,4014, 4990, Tech Specs and Const. | | SR | | |
| iii | | Acceptance of formwork before start concreting | | B | Physical / visual | beofre start of each concreting | As per provisions and tolerances, Tech Specs | | SR | | |
| 11 | EMBEDDED PART(INCLUDING LAYING OF RAILS & ANCHOR FASTENERS) | | | | | | | | | | |
| i | | Position and levels of embedded parts | As agreed / required | B | Physical/ measurement | 100% | As per drawing, Tech Specs and Const. Drawings | | SR | | Exposed surfsce of the embeded parts other than holding down bolts are to be painted with primer ,chlorinated , rubber baed zinc phosphate |
| ii | | Position depth and size of bolt hole | As agreed / required | B | Physical/ measurement | Random in each shift | As per drawing, Tech Specs and Const. Drawings | | SR | | |
| iii | | Location verticality of pipe sleeve/opening of bolt hold | As agreed / required | B | Physical/ measurement | Random in each shift | As per drawing, Tech Specs and Const. Drawings | | SR | | |
| iv | | Laying of rails under supervision of NTPCs specilised agency. | As agreed / required | B | Physical/ measurement | Random in each shift | As per drawing, Tech Specs and Const. Drawings | | SR | | |
| v | | Welding / tieing of embeddment to reinforce-ment | As agreed / required | B | Physical/ measurement | Random in each shift | As per drawing, Tech Specs and Const. Drawings | | SR | | |
| 12 | PRE-CAST CONCRETE | | | | | | | | | | |
| i | | Crushing strength | As required/ agreed | A | Physical | one sample of six cubes per 50 cum or part thereof | IS:516&IS; 456, Tech Specs and Const. Drawings | | SR/LB | √ | a minimum of three specimen shall be tested for 28 days comp. strength |
| ii | | Workmanship free from visual defects | As required/ agreed | B | Physical | 100% | Tech Specs and Const. Drawings | | SR | | The precast units shall be free from defects like honeycombing, reinforcement exposure and should have good finish. All relevant tests like workability, cube test shall be carried out as per IS 456-2000 Same as applicable to cast in situ concrete. |
| iii | | Dimension of finish structure | As required/ agreed | B | Measurement | 100% | As per IS:456, Tech Specs and Const. Drawings | | SR | | If the material already tested of the cast-in-situ concrete and part of the same is used for precast concrete, further testing is not required, otherwise testing is required for every 50 Cum. Of Concrete. |
| iv | | Workability | slump test apparatus | B | Physical | one sample every two hrs from mixing plant | IS:1199 &IS:456, Tech Specs and Const. Drawings | | SR/LB | | According to the mix design |
| v | | Water cement ratio | As agreed / required | B | Physical | At random at the time of batching | IS:1199 , Tech Specs and Const. Drawings | | SR/LB | | According to the mix design |
| vi | | Cement content | As agreed / required | B | Physical | At random at the time of batching | IS:1199 /tech spec, Tech Specs and Const. Drawings | | SR | | According to the mix design |
| vii | | Load Test | As agreed / required | A | Physical | 5% or as desired by EIC | IS:456/ As decided by NTPC Site Engr. Incharge., Tech Specs and Const. Drawings | | SR | √ | These tests shall also be carried out, in case of doubt regarding grade of concrete and poor quality. |
| 13 | JOINTS IN CONCRETE | | | | | | | | | | |
| i | | Check for the joint material - bitumen impregnated fibre board, PVC water stops, Sealing compound, Expanded polystyrene board, Hydrophillic strip, Acrylic polymer etc. | As per manufacturer Standards | A | Review of MTC | Each batch of delivery | Tech Specs and Const. Drawings, IS 1838, IS 1834, IS12200 | | MTC | √ | |
| ii | | Acceptance of installation of materials for Joints in concrete | As agreed / required | B | Acceptance | Each installation randomly | As per technical specifications and construction drawings | | | | |
| 14 | DAMP PROOF COURSE | | | | | | | | | | |
| i | | Check for the material - Hot bitumen and water proffing materials etc | As agreed / required | A | Review of MTC | Each batch of delivery at site | Tech Specs and Const. Drawings, IS 702 | | SR | √ | |
| ii | | Acceptance of damp proof course | As agreed / required | B | Acceptance | 100% | As per technical specifications and construction drawings | | SR | | |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | | 1<br>0 | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| 15 | **GROUTING** | | | | | | | | | | |
| i | | Check for the material | As agreed / required | A | Review of MTC | Each batch of delivery | As per technical specifications and construction drawings | | SR | √ | Check for chemical, epoxy, resin grouts etc |
| ii | | Check for the type of mix - fluid mix, plastic mix, stiff mix etc. | As agreed / required | B | Physical | Prior to start of work | As per technical specifications and construction drawings | | | | |
| iii | | Check for the mixing, placement, application and grout pressure | As agreed / required | B | Physical | Random in each shift | As per technical specifications and construction drawings | | SR | | |
| iv | | Check for the compressive strength | As agreed / required | A | Physical | Each batch of delivery | As per technical specifications and construction drawings | | SR | √ | |
| v | | Acceptance of the grouts | As agreed / required | B | Physical | Each grout section | As per technical specifications and construction drawings | | SR | | |
| 16 | **SLIPFORM SHUTTERING** | | | | | | | | | | |
| i | | Submission of Slipform Work system to be used | - | B | Submission | Before Comencement of work | As per specifications | | SR | | |
| ii | | Check for the Slipform shutters | As required | B | Physical | Before Comencement of work | As per specifications | | SR | | Check for water level system, Controls, Walkways etc. |
| iii | | Details Positions and arrangement of Jack rods | - | B | Approval | Before Comencement of work | As per specifications | | SR | | Submitted to Engineer for approval |
| iv | | Details of Proposed arrangement for continuous readings | - | B | Approval | Before Comencement of work | As per specifications | | SR | | Submitted to Engineer for approval |
| v | | Check for All type of openings, Chases, Fixing of Blocks and similar built-up features | As required | B | Physical | 100% during execution | Construction Drawings and specifications | | SR | | No any type of openings ,chases , blocks other than shown in the construction drawings or approved by Engineer shall be executed in the concrete. |
| vi | | Details of proposed method for concrete curing and protection | - | B | Approval | Before Comencement of work | Construction Drawings and specifications | | SR | | Submitted to Engineer for approval |
| vii | | Check of Concrete Curing and Protection | As required | B | Physical | At Random | Construction Drawings and specifications | | SR | | Concrete shall not remain uncured for period longer than 12 hours |
| viii | | Check for Sliding Operation | As required | B | Physical | Each Sliding | As per specifications | | SR | | Rate of Sliding, Delays in sliding, Discontunity or stop strat sliding to be checked |
| | | Monitoring of Sliding Portion | | | | | | | | | |
| ix | | Progress Height | As required | B | Physical | Six hourly intervals | As per specifications | | SR | | To be recorded in tabular form and on graphs immediately after each monitoring |
| x | | Centre line in relation to the centers at the base | As required | A | Physical | Six hourly intervals | As per specifications | | SR | √ | To be recorded in tabular form and on graphs immediately after each monitoring |
| xi | | Internal wall faces in relation to the concrete at the base | As required | B | Physical | Six hourly intervals | As per specifications | | SR | | To be recorded in tabular form and on graphs immediately after each monitoring |
| xii | | Wall thickness | As required | B | Physical | Six hourly intervals | As per specifications | | SR | √ | To be recorded in tabular form and on graphs immediately after each monitoring |
| xiii | | Twist | As required | B | Physical | Six hourly intervals | As per specifications | | SR | √ | To be recorded in tabular form and on graphs immediately after each monitoring |
| xiv | | Verticality of the structure | Optical Theodolight | B | Physical | Every day in morning | As per specifications | | SR | | To be recorded in tabular form and on graphs immediately after each monitoring |
| xv | | Check for Tolerances for chimney construction | As required | B | Physical | For every day monitoring | As per specifications | | SR | | |
| | | | | | | | | | | | |
| 4.00 | **BRICK MASONARY** | | | | | | | | | | |
| 1 | **Test on Bricks** | | | | | | | | | | |
| i | | Check for Dimensions , shape | As required/ agreed | A | Measurement/ Physical Test | As per relevant IS Code/ One Sample for 30,000 Nos. or part thereof | IS: 1077, Tech Specs and Const. Drawings | | Inspection Report | √ | Efflorescence shall be checked at each source. |
| ii | | compressive strength, water absorption, warpage efflorescence. | As required/ agreed | B | Measurement/ Physical Test | As per relevant IS Code/ One Sample for 30,000 Nos. or part thereof | IS: 1077, IS:3495 part I ( Compressive Strength) Part II ( Water Absorbtion) Part III( Efflorescence) Part IV ( War page), Tech Specs and Const. | | | √ | Preconditioning of brick shall be done as per IS. For comperssive strength, warpage and water absorbtion |
| 2 | **Test on Mortar** | Compressive strength, consistency and water retentivity for each portion of walls, plasters and ceilings. | As required/ agreed | B | Test | At random | IS 2250-1981, Tech Specs and Const. Drawings | | LB | | Cement used in mortar shall confirm to either IS 269: 1976 or IS 455- 1976 sand shall confirm to IS 2116 -1980 |
| 3 | **Masonry construction** | Acceptance of Workmanship, verticality and alignment | As agreed / required | B | Visual/ Physical | 100% | IS 2212, IS 1905 , Tech Specs and Const. Drawings | | SR/LB | | |
| 5.00 | **FINISHING AND ALLIED WORKS** | | | | | | | | . | | |
| 1 | **MATERIALS- FINE SAND, SAND FOR PLASTERING** | | | | | | | | | | |
| i | | Deleterious Material | As agreed / required | B | Physical | Once per source | IS : 2386 (Part-I &II) & IS :2116, Tech Specs and Const. Drawings | | SR | | |
| ii | | Grading | As agreed / required | B | Physical | 50 Cum./or part thereof | IS:3150,1542& Apprd. drgs, Tech Specs and Const. Drawings | | SR | | Table –I of IS:2116 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | 1<br>0 | | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| iii | | Galvanized hexagonal wire netting for lath plastering | As agreed / required | B | Review of MTC | Each batch of delivery | , Tech Specs and Const. Drawings | | SR | | |
| iv | | Check for the thickness and finishing of plaster | As agreed / required | B | Visual/ Measurement | Random in each shift | As per IS 1661 , Tech Specs and Const. Drawings | | SR/LB | | |
| 2 | PLASTERING | | | | | | | | | | |
| i | | Check for defects and the remedial measure for bond filler , blistering , cracking and crazing , efflorescence and irregularity of surface texture | As agreed / required | B | Visual/ Physical | Random in each shift | Tech Specs and Const. Drawings, IS: 1661 | | SR | | |
| ii | | Truness of plastering system | As agreed / required | B | Visual/ Physical | Random in each shift | Tech Specs and Const. Drawings | | SR | | finished plaster surface shall not show any deviation more than 4 mm when checked with straight edge of 2 m length |
| iii | | Acceptance of Grooves and finishing | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings | | SR | | |
| 3 | STONE GRIT PLASTER/ GRANULAR TEXTURED COAT FINISH | | | | | | | | | | |
| i | | Check for Preparation of surface | As agreed / required | B | Physical | Random in each shift | Tech Specs and Const. Drawings | | SR | | |
| ii | | Check for material - Size of chips | As agreed / required | B | Physical | Random in each shift | Tech Specs and Const. Drawings | | SR | | |
| iii | | Acceptance of Grooves and finishing | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings | | SR | | |
| 4 | WATER PROOFING SYSTEM | | | | | | | | | | |
| i | | Check for the material | As agreed / required | A | Physical and Review of MTC | Each lot of delivery | Tech Specs and Const. Drawings, | | SR/ MTC | √ | |
| ii | | Acceptance of water proofing system - Application, fixing, laying | As agreed / required | B | Physical | 100% | Tech Specs and Const. Drawings | | SR | | Water pounding test shall be done |
| 5 | FALSE CEILING | | | | | | | | | | |
| i) | | Check for the Materials - Glass Reinforced Gypsum (GRG), Pre-painted coil coated steel false ceiling system etc. | As agreed / required | A | Physical and MTC Review | Each batch of delivery | As per relevant IS and Tech. Specs / Manufacturer's TC | | -do- | √ | |
| ii) | | Acceptance of installation | As agreed / required | B | Physical / measurements | Each installation | -do- | | -do- | | All supports , hangers , accessories shall be as per Tech. Specifications/ approved manufacturer's recommendations |
| | | | | | | | | | | | |
| 6.00 | PAINTING SYSTEM - All surfaces | | | | | | | | | | |
| 1 | Check for the Materials and accessories | White wash, Distemper and all types of Primer and Paints - Check for Shade, type from brand and manufacturer as approved by NTPC EIC | As agreed / required | A | Review of MTC | Each batch of delivery | Tech Specs and Const. Drawings | | SR/MTC | √ | Mfr.'s T.C. shall be correlated with the consignment received. |
| 2 | Check for Surface prepration | | As agreed / required | B | Physical /visual | Random in each shift | Tech Specs and Const. Drawings | | SR | | |
| 3 | Check for DFT of painted surfaces | | As agreed / required | B | Physical | Each surface at random | Tech Specs and Const. Drawings | | SR | | |
| 4 | Acceptance of painted surfaces | | As agreed / required | B | Physical | Each surface at random | Tech Specs and Const. Drawings | | SR | | |
| 6.10 | CHIMNEY PAINTING | | | | | | | | | | |
| i | | Requirements for Steel Surfaces | As Required | B | Physical | Randomly | Tech Specs and Const. Drawings | | SR | | No of Coats applied and DFT/WFT to be checked as per specified |
| ii | | Requirements for Cast Iron Surfaces | As Required | B | Physical | Randomly | Tech Specs and Const. Drawings | | SR | | No of Coats applied and DFT/WFT to be checked as per specified |
| iii | | Requirements for Concrete Surfaces | As Required | B | Physical | Randomly | Tech Specs and Const. Drawings | | SR | | No of Coats applied and DFT/WFT to be checked as per specified |
| iv | | Material Requirements | As Required | B | Physical | Randomly | Tech Specs and Const. Drawings | | SR | | Requirement of DFT to be checked as per Specifications. Procurement to be done from approved/acceptable manufacturer/source |
| v | | Preparation of Surfaces | As Required | B | Physical | Randomly | Tech Specs and Const. | | SR | | |
| vi | | Application of Paint | As Required | B | Physical | Randomly | Tech Specs and Const. Drawings | | SR | | AS per recommendations by Manufacturer along with Relevant IS Codes and Specification requirements |
| | | | | | | | | | | | |
| 7.00 | DOORS , WINDOWS VENTILATORS & GRILL | | | | | | | | | | |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | | | | ANNEXURE- IV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | | 1<br>0 | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| 1 | **Check for the material/ items for all type of timber, flush doors, Particle doors, wire guage, Aluminium doors, Fire proof doors, windows fittings, Anodized aluminium works, Mortice locks, Automatic operating system etc received at site** | Review of MTC / make or/and Physical checks, tests report ( if MTC is not available) | As agreed / required | A | Review of MTC/ Physical | for each batch of delivery | Tech Specs and Const. Drawings | | SR | √ | |
| 2 | **Wood work in frames** | Wood work in frames - Check for dimensions, surface finish and rebating etc. | As agreed / required | B | Physical | Random for each installation | Tech Specs and Const. Drawings | | SR | | |
| 3 | **Wardrobe shutter and show cases** | | | | | | | | | | |
| i | | Check for material as per IS 3087 and 3097 - from NTPC approved source | As agreed / required | B | Physical | one sample for each section for each lot of delivery | Tech Specs and Const. Drawings, IS 3087 and 3097 | | SR | | |
| ii | | Acceptance of fixing after completion | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings, IS 3087 and 3098 | | SR | | |
| 4 | **Pelmets** | | | | | | | | | | |
| i | | Check for material as per IS 3087/ 3097 - from NTPC approved source | As agreed / required | B | Physical | one sample for each section for each lot of delivery | Tech Specs and Const. Drawings, IS 3087/ 3097 | | SR | | |
| ii | | Acceptance of fixing after completion | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings, IS 3087/ 3098 | | SR | | |
| 5 | **MS Grills** | | | | | | | | | | |
| i | | Check for the material for section and weight from NTPC approved source | As agreed / required | A | Physical | one sample for each section for each lot of delivery | Tech Specs and Const. Drawings | | SR | √ | |
| ii | | Check for fabrication done at approved workshop | As agreed / required | B | Physical | Random | Tech Specs and Const. Drawings | | SR | | |
| | | Acceptance of fixing of MS Grills | As agreed / required | B | Acceptance | Random | Tech Specs and Const. Drawings | | SR | | |
| 6 | **Fitting and fixtures - MS sliding door bolts, tower bolts, pull bolt lock, MS handles, Safety Chains, brass locks, brass latch, hydraulic floor springs & door closers, etc** | Check for fitting items as per relavent IS codes, tech specifications and BOQ- from NTPC approved source | As agreed / required | B | Physical and acceptance | Five samples for each item for each lot of delivery | Tech Specs and Const. Drawings | | SR | | |
| 7 | **Fitting and fixtures - Aluminium sliding door bolts, tower bolts, pull bolt locks, handles, door stoppers etc.** | Check for fitting items as per relavent IS codes, tech specifications and BOQ- from NTPC approved source | As agreed / required | B | Physical and acceptance | Five samples for each item for each lot of delivery | Tech Specs and Const. Drawings | | SR | | |
| 8 | **Fire proof doors** | | | | | | | | | | |
| i | | a) Check for the Fire Proof Doors | As required/ agreed | A | Review of MTC | Each lot | As per Technical Specifications and approved drawings, IS 3614 Part (I &II), TAC | | MTC | √ | |
| ii | | b) Check for DFT and Fire Retardency of Paint | As required/ agreed | B | Physical | Each Door | As per Technical Specifications and approved drawings, IS 3614 Part (I &II) | | SR/LB | | |
| 9 | **Acceptance of all type fittings after fixing** | Acceptance of fittings after completion | As agreed / required | B | Physical and acceptance | Random for each type of fitting | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| 8.00 | **GENERAL STEEL WORK** | | | | | | | | | | |
| 1 | **Check for Material** | Review of MTC/ make / Physical checks, tests ( if MTC is not available) | As agreed / required | A | Review of MTC for each delivery | For each batch of delivery | Tech Specs and Const. Drawings | | SR | √ | |
| 2 | **Rolling shutters** | | | | | | | | | | |
| i | | Check for surface finish and thickness of plate of rolling shutters of approved make and DFT | As agreed / required | B | Physical | Random for each batch of delivery | Tech Specs and Const. Drawings | | SR | | |
| ii | | Acceptance of rolling shutters after fixing | As agreed / required | B | Physical and acceptance | Random | Tech Specs and Const. Drawings | | SR | | |
| 3 | **Steel Glazed doors and T-iron frames sections** | | | | | | | | | | |
| i | | Check for shape, tolerances, thickness, welding and finishing of sections (Check MTC whereever applicable) | As agreed / required | A | Review of MTC for each delivery | Random for each delivery | Tech Specs and Const. Drawings | | SR | √ | |
| ii | | Acceptance of Steel Glazed doors and T-iron frames sections after fixing | As agreed / required | B | Physical and acceptance | Random for each installation | Tech Specs and Const. Drawings | | SR | | |
| 4 | **Pressed steel pressed frames/ doors** | | | | | | | | | | |
| i | | Check for shape, tolerances, thickness, welding and finishing (Check MTC whereever applicable) | As agreed / required | A | Review of MTC for each delivery | Random for each delivery | Tech Specs and Const. Drawings, IS4351, IS2202 | | SR | √ | |
| ii | | Acceptance of Pressed steel pressed doors after fixing | As agreed / required | B | Physical and acceptance | Random for each installation | Tech Specs and Const. Drawings | | SR | | |
| 5 | **Fencing and Gates** | | | | | | | | | | |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | | 1<br>0 | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| i) | Check for Materials for fencing and gates | PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1566), Reinforced barbed tape galvanised (IS 2629) etc. | As agreed / required | A | Review of MTC | Each batch of delivery | Tech Specs and Const. Drawings | | SR/MTC | √ | Mfr.'s T.C. shall be correlated with the consignment received. |
| ii) | Check for alignments, erection painting, DFT etc. | | As agreed / required | B | Physical / measurements | Each installation | Tech Specs and Const. Drawings | | SR | | Erection shall be as per NTPC Tech. Specs. |
| ii) | Acceptance of the installation and working | | As agreed / required | B | Physical / measurements | Each installation | Tech Specs and Const. Drawings | | SR | | Erection shall be as per NTPC Tech. Specs. |
| 6 | **Galvanised Chicken Wire Mesh** | Check for Guage and Dimensions from NTPC approved Source | As agreed / required | B | Acceptance | Random for each delivery | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| 9.00 | **FLOOR FINISHES AND ALIED WORKS** | | | | | | | | | | |
| 1 | **Cement Concrete Flooring** | | | | | | | | | | |
| i | | Check for execution of concreting | As agreed / required | B | Physical | Random in each shift | Tech Specs and Const. Drawings | | SR | | |
| ii | | Check for providing and fixing glass/ PVC strips in joints | As agreed / required | B | Physical | Random in each shift | Tech Specs and Const. Drawings | | SR | | |
| iii | | Check for laying, polishing, curing, finishing for terrazzo, marble chip flooring | As agreed / required | B | Physical | Random in each shift | Tech Specs and Const. Drawings | | SR | | |
| iv | | Acceptance of lines, levels and finishing | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| 10.00 | **SANITORY INSTALLATIONS** | | | | | | | | | | |
| 1 | | Check for size and surface finish of all sanitory items and fixtures from NTPC approved sources, (Check MTC whereever applicable) | As agreed / required | A | Physical / review of MTC | Each lot of delivery as per Specifications | Tech Specs and Const. Drawings | | SR | √ | To be procured from NTPC approved source |
| 2 | | Acceptance of installations of all sanitory items and fixtures | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings | | SR | | |
| 3 | **SCI, CI, S&S Pipes & Fittings etc** | | | | | | | | | | |
| i | | Check for Work man ship and finish | As agreed / required | B | Visual | Random | Tech Specs and Const. Drawings | | SR | | |
| ii | | Check for Unit weight and Dimensions | As agreed / required | B | Physical | Random | Tech Specs and Const. Drawings | | SR | | |
| iii | | Hydrostatic test | As agreed / required | A | Review of MTC for each delivery | Each lot of delivery as per Specifications | Tech Specs and Const. Drawings | | SR | √ | |
| | | | | | | | | | | | |
| 11.00 | **WATER SUPPLY AND ALL TYPES OF FITTINGS** | | | | | | | | | | |
| 1 | | Check for size and surface finish of all water supply, GI/ MS pipes and fittings, Photo Voltaic Control System etc from NTPC approved sources (Check MTC whereever applicable) | As agreed / required | A | Physical / review of MTC | each delivery as per Specifications | Tech Specs and Const. Drawings | | SR | √ | To be procured from NTPC approved source |
| 2 | | Acceptance of installations of all water supply, GI pipes and fittings | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings | | SR | | |
| 3 | **CI, S&S Pipes & Fittings** | | | | | | | | | | |
| i | | Check for Work man ship and finish | As agreed / required | B | Visual | Random as per Specifications | Tech Specs and Const. Drawings | | SR | | |
| ii | | Check for Unit weight and Dimensions | As agreed / required | B | Physical | Random | Tech Specs and Const. Drawings | | SR | | |
| iii | | Hydrostatic test | As agreed / required | A | Physical / review of MTC | Each lot of delivery as per Specifications | Tech Specs and Const. Drawings | | SR | √ | |
| 4 | **Polyethylene Water Storage Tanks** | | | | | | | | | | |
| i | | Check for material of tanks from NTPC approved sources | As agreed / required | A | Physical / review of MTC | Each lot of delivery as per Specifications | Tech Specs and Const. Drawings | | SR | √ | |
| ii | | Aceptance for instllation and fitting (IS 12701) | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| 12.00 | **DRAINAGE AND SANITATION** | | | | | | | | | | |
| 1 | **Sanitary appliances** | | | | | | | | | | |
| i | | Check for Viterous China, Glazed, ceramic sanitary appliances (Water closets, Wash basins, urinals) etc. | As agreed / required | A | Physical / review of MTC | each delivery as per Specifications | Tech Specs and Const. Drawings | | SR | √ | To be procured from NTPC approved source |
| ii | | Acceptance of installation of Viterous China, Glazed, ceramic sanitary appliances (Water closets, Wash basins, urinals) etc. | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings | | SR | | |
| 2 | **SW Pipes and RCC Pipes** | | | | | | | | | | |
| i | | Check for size and surface finish of Pipes from NTPC approved sources | As agreed / required | A | Physical | 100% after delivery | Tech Specs and Const. Drawings, IS458, IS 1536 | | SR | √ | |
| ii | | Testing of Joints | As agreed / required | B | Physical | 100% | Tech Specs and Const. Drawings | | SR | | |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | | 1<br>0 | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| i | | Acceptance of installations of Pipes | As agreed / required | B | Acceptance | 100% | Tech Specs and Const. Drawings | | SR | | Acceptance tests shall be done as per specifications |
| 3 | **CI Pipes, Covers and Frames** | | | | | | | | | | |
| i | | Check for CI and SFRC covers and frames as per IS 1726 and IS 12592 from NTPC approved sources (Check MTC whereever applicable) | As agreed / required | A | Physical / review of MTC | Each lot of delivery | Tech Specs and Const. Drawings, IS 1536, IS 12592 | | SR | √ | |
| ii | | Acceptance of installations of CI Pipes, Covers and Frames | As agreed / required | B | Acceptance | 1 | Tech Specs and Const. Drawings | | SR | | |
| 4 | **RCC manholes** | Acceptance of RCC manholes after completion | As agreed / required | B | Acceptance | 1 | Tech Specs and Const. Drawings , IS 4111 | | SR | | |
| | | | | | | | | | | | |
| 13.00 | **FOUNDATION SYSTEM** | | | | | | | | | | |
| 1 | **SHALLOW FOUNDATIONS** | | | | | | | | | | |
| i | | Check for the foundation excavation - Location, Layout, size, depth etc | As required / agreed | B | Physical | Each location | As per technical specifications and construction drawings | | SR | √ | lines and levels to be checked |
| ii | | Check for the foundation casting - Layout, Shape, dimensitions, Reinforcement, concreting, curing etc | As required / agreed | B | Physical | Each foundation | As per technical specifications and construction drawings | | SR | | lines and levels to be checked. Concrete Grade to be checked as per Mix Design |
| | | | | | | | | | | | |
| 14.00 | **SHEETING AND OTHER WORKS** | | | | | | | | | | |
| 1 | | Check for Material like modular areated panel, permanently colour coated sheets , metal decking , pre-engineered buildings, AC sheeting, Fire proof doors and insulations (all tests as per tehcnical Specifications) | As per manufacturer Standards | A | Review of MTC | Each batch of delivery | Tech Specs and Const. Drawings | | MTC | √ | 1)FQP for structural steel shall also be applicable.2) For aluminium door/windows, check for anodisation as per Tech. Spec. 3) Fire proof doors shall be procured from TAC Approved parties as per relevant IS/Tech. 4) For aluminium cladding grade of alminium to be checked. |
| 2 | | Check for Storage at Site | As agreed / required | B | Visual | Random in each shift | Tech Specs and Const. Drawings | | SR | | |
| 3 | | Installation, lap alignment & workmanship. | As agreed / required | B | Visual/ Physical | Random in each shift | Tech Specs and Const. Drawings | | SR | | No gas cutting of sheets acceptable . Profile sheets will be kept covered in weather proof storage &stored at accurate height to avoid any exposure of actual water. Principle of first in and first out shall be apply for erecting the sheets. |
| 4 | | Installation of lining &insulation &check thermal insulationfor wall clading for thickness , density , thermal conductivityn at 50 deg c and all other tests as per IS:8183 | As agreed / required | B | Testing | 100% | Tech Specs and Const. Drawings | | SR | √ | |
| 5 | | Check for the installation, alignments, finishing etc | As agreed / required | B | Visual/ Physical | Random in each shift | Tech Specs and Const. Drawings | | SR/LB | | |
| 6 | | Fasteners for sheeting work | As agreed / required | B | Review of TC including 1000 hrs salt spray test | 100% | Tech Specs and Const. Drawings | | SR/LB | | |
| 7 | | Acceptance of each type of installation | As agreed / required | B | Visual/ Physical | Each installation | Tech Specs and Const. Drawings | | SR/LB | | |
| | | | | | | | | | | | |
| 15.0 | **PILING WORK (IF APPLICABLE)** | | | | | | | | | | |
| 15.1 | **Execution** | | | | | | | | | | |
| i | | 100 mm Dia Borehole | As required | A | Physical | 100% | NTPC Tech. Specs | | SR/LB | √ | If carried out by the contractor |
| ii | | Pile layout | Total station | B | Measurement | 100% | As per appd. Drawings and technical specification | | SR/LB | √ | |
| iii | | Recording ground level | As required | B | Measurement | Random | IS:2911, as per appd. Drawings and technical | | SR/LB | √ | |
| iv | | Cleaning/Flushing of pile bore | As required | B | Visual | Random | As per appd. Drawings and technical specification | | SR/LB | √ | |
| v | | Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon. | As required | B | Measurement | 100% | As per appd. Drawings and technical specification | | SR/LB | √ | |
| vi | | Trial mix to ascertain the workability and cube strength | After receiving the recommended mix design from specialist agency, | B | Physical | One for each mix proportion | NTPC tech specification | | SR/LB | √ | Necessary correction for moisture content and water absorption according to mix design recommendation may be carried out during the trial mix |
| vii | | Cement content | As required | B | Physical | Once per shift | As per approved design mix. | | SR/LB | √ | At batching plant |
| viii | | Pouring of concrete to project above cutoff level. | As required | B | Measurement | 100% | As per appd. Drawings and technical specification | | SR/LB | √ | |
| ix | | Pile termination level | SPT & core recovery | A | Soil data | As per NTPC specifications | As per appd. Drawings and technical specification | | SR | √ | |
| 15.2 | **Testing** | | | | | | | | | | |
| i | | Bentonite | IS:2720 | A | Physical / testing | Once per source | As per IS:2720 / tech. Specs. | | SR/LB | √ | Review of test report |
| ii | | Density check on sample of mud collected from pile bore bottom | Sample collection | A | Physical | As per Tech. Spec. | As per NTPC Tech Spec. | | SR/LB | √ | Tests to be done before placing concrete. Samples to be collected from pile bore bottom. |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : CIVIL WORK<br>SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc. | | QP NO. :<br>REV. NO .:<br>DATE :<br>PAGE : | | 1<br>0 | PROJECT:<br>PACKAGE:<br>CONTRACT NO.<br>MAIN CONTRACTOR | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| iii | | Slump test of concrete | IS:1199 | B | Physical | Every 2 hrs at pouring point of concrete | IS:2911, As per appd. Drawings and technical specification | | SR/LB | √ | |
| iv | | Cube sampling for works cube test | IS:456 | B | Physical | One set of 6 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier. | IS:2911, As per appd. Drawings and technical specification | | SR/LB | √ | |
| v | | Initial pile load test, Vertical (Compression), Lateral (horizontal) and pullout (tension). | IS:2911 / as required | A | Testing | 100% for 3 nos. for each type or as specified in BOQ / Tech. Spec. | IS:2911, As per appd. Drawings and technical specification | | SR/LB | √ | In case of compression test method the loading shall be cyclic. |
| vi | | Routine pile tests, compression and horizontal | Calibrated dial gauges etc. as required. | A | Testing | 100% for 0.5% of the total number of piles provided for each type of test/Tech. Spec. | IS:2911, As per appd. Drawings and technical specification | | SR/LB | √ | Routine Test shall be conducted by direct loading method. |
| vii | | Integrity Tests | PEM | A | Testing | 100% | IS:2911, As per appd. Drawings and technical specification and suppliers manual | | Test Report | √ | CHP |
| | | | | | | | | | | | |
| 16.0 | SPECIAL ITEMS | | | | | | | | | | |
| 16.1 | Earthing Mat (Grounding System) | | | | | | | | | | |
| i | Material | Earthing mat | As agreed / required | A | EIC Approved source and review of MTC/ test reports | Each lot of delivery as per Specifications | As per relevant IS and Tech. Specs / Manufacturer's, IS 3043 | | SR/MTC | √ | |
| ii | | Weld sizes & length | Visual/Tape | B | Visual/ Measurement | 1 | Tech Specs and Const. Drawings | | | | NTPC approved electrodes shall be used |
| iii | | D P test | DP test Kit | A | Physical | 10% at random of the offered lot | Tech Specs and Const. Drawings | | TR | √ | |
| iv | | Earth test | Earthing test kit | A | Physical | 1 | Tech Specs and Const. Drawings, | | SR | √ | |
| 16.2 | Bitumen layer for tank foundation | | | | | | | | | | |
| i | Material | Grade of bitumen | As agreed / required | A | EIC Approved source and review of MTC/ test reports | Each lot of delivery as per Specifications | As per relevant IS and Tech. Specs /MTC | | SR/MTC | √ | |
| ii | Acceptance and workmanship | Application / workmanship | As agreed / required | B | Physical | Random | Tech Specs and Const. Drawings | | SR | | |
| 16.3 | Composite Aluminium Panels and structural glazing | | | | | | | | | | |
| i | Material | Type of aluminium panels / structural glazing / fasteners and fixtures / silicon sealant | As agreed / required | A | EIC Approved source and review of MTC/ test reports | Each lot of delivery as per Specifications | Technical specifications / drawings | | SR/MTC | √ | MTC shall cover all the properties / parameters as per technical specifications |
| ii | Acceptance and workmanship | Installation / workmanship | As agreed / required | B | Physical | Random | Technical specifications / drawings | | SR | | |
| | | | | | | | | | | | |
| | | **LEGEND: D *** Records, indentified with "Tick" (√) shall be essentially included by supplier in QA documentation. | | | | | | **DOC. NO.:** CS-4140-109-2 | **REV:** | | |
| | | **Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB** | | | | | | | | | |
| Manufacturer/ Sub-supplier | Main-supplier | **Categorization Witnessing & Accepting (As per NTPC QA&I System)**<br>**Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer** ;**SR** = Site Register , **TR**= Test Report, **MTC =** Manufacturer's Test Certificate | | | | | **For NTPC USE** | | | | |
| Signature | | This document shall be read in conjunction with NTPC Tech. Specifications, BOQ, Drawings | | | | | | **REVIEWED BY** | **APPROVED BY** | | **APPROVAL SEAL** |
| | | | | | | | | | | | |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | | | | ANNEXURE- V |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : STRUCTURAL STEEL WORK | | QP NO. : | | 2 | PROJECT: | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| | | | | REV. NO .: | | 0 | PACKAGE: | | | | |
| | | SUB-SYSTEM : FABRICATION & ERECTION | | DATE : | | | CONTRACT NO. | | | | |
| | | | | PAGE : | | | MAIN CONTRACTOR | | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| 1.00 | MATERIALS | | | | | | | | | | |
| i | | Structural steel procured from NTPC approved sources-Mechanical (YS, UTS, Elg, UT if specified),,and Chemical properties (CE as per IS) | | A | Review | For each batch of each section delivered at site | Technical Specification and Construction Drawings, IS 2062 | | SR | √ | Correlated MTC shall be verified. In the event of non submission of MTC , sample shall be selected by FQA for testing |
| 2.00 | FIT-UP | | | | | | | | | | |
| 2.01 | | Marking and Cutting | As agreed / required | B | Visual & Measurement | Each plate/ Section | Tech Specs and Const. Drawings/ Approved cutting plan | | SR | | |
| 2.02 | | Match markings for trial assembled components | As agreed / required | B | Physical | Each fit-up | Tech Specs and Const. Drawings | | SR | | |
| 2.03 | | Weld Fit Up | As agreed / required | B | Physical | Each fit-up | Tech Specs and Const. Drawings | | SR | √ | Edge Preparation/ Gap/ Alignment |
| | | | | | | | | | | | |
| 3.00 | PRE HEATING (wherever applicable) | | | | | | | | | | |
| 3.01 | | Pre-Heating Temperature | As agreed / required | B | Measurement | Each pre-heating | Tech Specs and Const. Drawings, Approved WPS | | SR | √ | |
| 3.02 | | Post Weld Heat Treatment (PWHT), if required | As agreed / required | A | Time & Temperature | Each PWHT | Tech Specs and Const. Drawings, Approved WPS | | SR | √ | |
| | | | | | | | | | | | |
| 4.00 | WELDING REQUIREMENTS | | | | | | | | | | |
| 4.01 | | PQR and Welder's Qualification | As agreed / required | A | Physical | Each welder | Approved WPS/ PQR, AWS-D1.1/ASME-IX, Tech Specs and Const. Drawings | | Test Report | √ | |
| 4.02 | | Welding consumables | As agreed / required | B | Physical | Random in each shift | Approved WPS/ Owner Rationalized list of Electrodes. | | SR | √ | |
| 4.03 | | Sequence of welding | As agreed / required | B | Physical | Random in each shift | Tech Specs and Const. Drawings, Agreed scheme | | SR | | |
| 4.04 | | Removal/ grinding of temporary attachments | As agreed / required | B | Measurement | All cleats/ attachments | Tech Specs and Const. Drawings, IS-7215/Approved Drg. | | SR | | |
| 4.05 | | Completeness after welding-Dimensions/ distortion | As agreed / required | B | Visual | Each structure component | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| 5.00 | NON DESTRUCTIVE AND DESTRUCTIVE TESTING | | | | | | | | | | |
| 5.01 | Fillet Welds | | | | | | | | | | |
| 5.01.01 | | Visual | As required/ agreed | B | Visual/ Measurement | Each welded joint | As per technical specifications and construction drawings | | SR | | As per requirement of Owner Engineer |
| 5.01.02 | | Macro-Etch Examination | As required/ agreed | B | Physical | Main fillet weld with min one joint per built up beam, columns and crane girders | As per technical specifications and construction drawings | | SR | √ | |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | ANNEXURE- V |
|---|---|---|---|---|---|---|
| | | ITEM : STRUCTURAL STEEL WORK | QP NO. : | 2 | PROJECT: | FLUE GAS DESULPHURISATION SYSTEM PACKAGE |
| | | | REV. NO .: | 0 | PACKAGE: | |
| | | SUB-SYSTEM : FABRICATION & ERECTION | DATE : | | CONTRACT NO. | |
| | | | PAGE : | | MAIN CONTRACTOR | |

| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| 5.01.03 | | Dye Penetration Test (DPT) | As required/ agreed | B | Physical | 25% weld length of tension member of crane girder- For crane girder<br><br>5% of Weld length with min. 300mm at each location - Except Crane Girder, for all other Fillet Welds | As per technical specifications and construction drawings | | SR | √ | |
| 5.02 | **Butt Welds** | | | | | | | | | | |
| 5.02.01 | | Visual | As required/ agreed | B | Visual | Random in each shift | As per technical specifications and construction drawings | | SR | | |
| 5.02.02 | | Dye Penetration Test | As required/ agreed | B | Physical | 100% DPT after back gouging on all butt welds except for coal bunker bins<br><br>10% DPT after back gouging-For coal bunker bins | As per technical specifications and construction drawings | | SR | | All butt welds to be back gouged before DPT |
| 5.02.03 | | Mechanical testing on production test coupons | As required/ agreed | A | Physical | Min. one joint per built up beams, coloums and crane girder. | As per technical specifications and construction drawings | | SR | √ | Test on production test coupons |
| 5.02.04 | | Radiography Test (RT) | As required/ agreed | A | Physical | 100% RT on butt welds of tension flange (bottom flange) of crane girders<br><br>5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins<br><br>10% RT weld length of each welder on butt welds, except for crane girders and coal bunk | As per technical specifications and construction drawings | | SR | √ | In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.<br><br>Wherever RT is not feasible UT to be carried out with the approval of the Engineer |
| 5.03 | **Full Penetration Welds (Other than butt welds)** | | | | | | | | | | |
| 5.03.01 | | Ultrasonic Testing (UT) | As required/ agreed | A | Physical | 100% UT on the web to flange joint of crane girder<br><br>10% UT on other full penetration joints | As per technical specifications and construction drawings | | IR | √ | In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular loaction. Acceptance criteria of NDT on welds shall be as per AWS D1.1. |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | ANNEXURE- V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : STRUCTURAL STEEL WORK | | QP NO. : | | 2 | PROJECT: | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| | | | | REV. NO .: | | 0 | PACKAGE: | | | | |
| | | SUB-SYSTEM : FABRICATION & ERECTION | | DATE : | | | CONTRACT NO. | | | | |
| | | | | PAGE : | | | MAIN CONTRACTOR | | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| 5.04 | NON DESTRUCTIVE AND DESTRUCTIVE TESTING FOR CHIMNEY STEEL LINER | | | | | | | | | | |
| i | | Visual examination | As required/ agreed | B | Visual | 100% | As per technical specifications and construction drawings, IS 822, AWS D 1.1 | | SR | √ | As per requirement of NTPC Engineer |
| ii | | DPT | As required/ agreed | B | Physical | 100% | As per technical specifications and construction drawings, IS 822, AWS D 1.1 | | IR | √ | |
| iii | | RT | As required/ agreed | A | Physical | 10% FOR SHOP BUTT WELD AND 15% FOR SITE BUTT WELDS | As per technical specifications and construction drawings, IS 822, AWS D 1.1 | | | | |
| | | | | | | | | | | | |
| 6.00 | FOUNDATION CHECKS | | | | | | | | | | |
| 6.01 | | Dimensions and levels | As agreed / required | B | Physical/ Measurement | Each Foundation | Tech Specs and Const. Drawings | | SR | √ | Shape, lines (including diagonal checks) |
| 6.02 | | Foundation Bolts and Embedments | As agreed / required | B | Physical/ Measurement | Each Foundation | Tech Specs and Const. Drawings | | SR | √ | Measurement of Verticality, Levels, pitch distance |
| | | | | | | | | | | | |
| 7.00 | PRE-ASSEMBLY CHECKS | | | | | | | | | | |
| 7.01 | | Punch Erection marks and match marks on members | As agreed / required | B | Visual/ Physical | Each structural member | Tech Specs and Const. Drawings | | | | Markings for - Assembly designation, Part number, Weight, Any other important identifications. |
| 7.02 | | Pre-assembly as per match mark | As agreed / required | B | Visual/ Physical | Each structural member | Tech Specs and Const. Drawings | | | | |
| 7.03 | | Camber, sweep and total length after trial assembly of structure. | As agreed / required | B | Visual/ Physical | Each structural member | Tech Specs and Const. Drawings | | SR | √ | |
| 7.04 | | Control assembly check at shop | As agreed / required | B | Visual/ Physical | Every first and tenth set of identical structure | Tech Specs and Const. Drawings | | | | |
| | | | | | | | | | | | |
| 8.00 | ERECTION CHECKS | | | | | | | | | | |
| 8.01 | | Alignment, slopes, level, tolerances of erected member | As agreed / required | B | Measurement | Each structural member | Tech Specs and Const. Drawings | | SR | √ | |
| 8.02 | | Tightening of bolts including foundation bolts with lock nuts | As agreed / required | B | Visual/ Physical | Each structural member | Tech Specs and Const. Drawings | | SR | √ | |
| 8.03 | | Acceptance of erected structure | As agreed / required | B | Visual/ Physical | Each erected structure | Tech Specs and Const. Drawings, IS 7215 and IS 12843 | | SR | √ | |
| 9.00 | INSTALLATION AND ALIGNMENT OF STEEL LINER | | | | | | | | | | |
| i | | Submission of Installation/ Erection Scheme/ methodology for all structures | - | B | Approval | Once prior to erection of each structure | Approved drawings and Technical Specifications | | SR | √ | |
| ii | | Check for Erection Marks | - | B | Visual | 100% | Approved drawings and Technical | | SR | | |
| iii | | Check for Installation of Steel Liners | As required | B | Visual/ Acceptance | 100% | Approved drawings and Technical Specifications | | SR | | |
| iv | | Check for Site Joints | As required | B | Visual/ Acceptance | 100% | Approved drawings and Technical Specifications | | SR | | |
| v | | Check for Installation of Inlet Transition Ducts | As required | B | Visual/ Acceptance | 100% | Approved drawings and Technical Specifications | | SR | | |

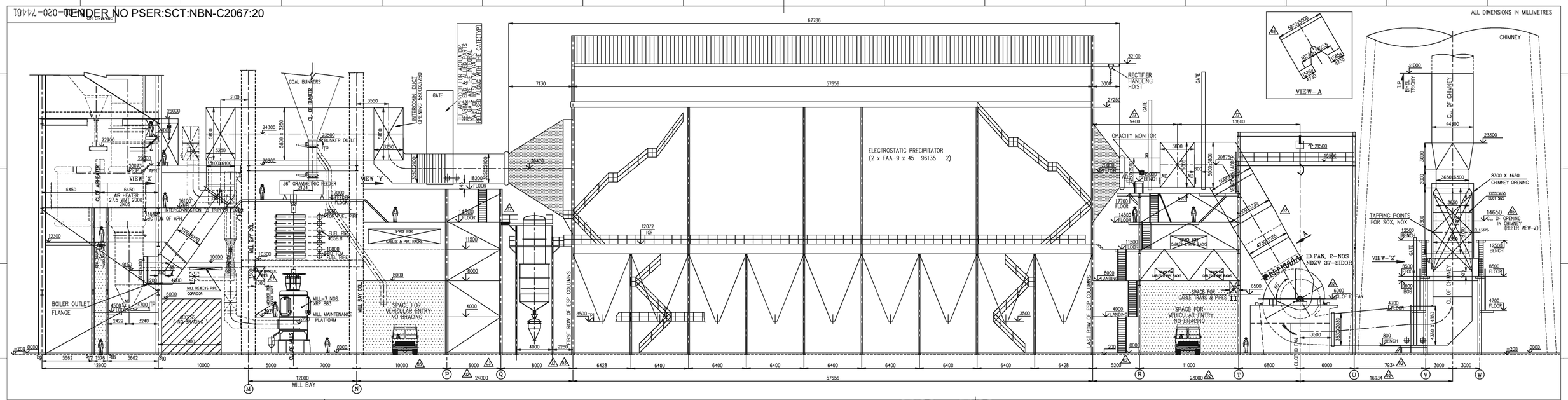
| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | ANNEXURE- V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : STRUCTURAL STEEL WORK | | QP NO. : | | 2 | PROJECT: | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| | | | | REV. NO .: | | 0 | PACKAGE: | | | | |
| | | SUB-SYSTEM : FABRICATION & ERECTION | | DATE : | | | CONTRACT NO. | | | | |
| | | | | PAGE : | | | MAIN CONTRACTOR | | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| vi | | Check for Installation of Insulations and Expansion Compensators | As required | B | Visual, Physical, Acceptance | 100% | Approved drawings and Technical Specifications | | SR | | Each layer of expansion Compensator tobe checked at shop for thickness, unit weight, tensile strength & elongation along with temp. withstandability for composite joints |
| vii | | Ensure the Erection of all steel structures along with permissible tolerances and their acceptance | As required | B | Visual/ Acceptance | 100% | Approved drawings and Technical Specifications | | SR | | |
| viii | | Check and approval for Dismantling, Modification and Re-erection, if required for any reason | As required | B | Visual/ Acceptance | 100% | Approved drawings and Technical Specifications | | SR | | |
| | | | | | | | | | | | |
| 10.00 | PAINTING SYSTEM | | | | | | | | | | |
| 10.01 | | Paining Materials and accessories | As agreed / required | A | Review of MTC | Each batch of delivery | Tech Specs and Const. Drawings | | SR/MTC | √ | Mfr.'s T.C. shall be correlated with the consignment received. |
| 10.02 | | Surface prepration | As agreed / required | B | Physical /visual | Random in each shift | Tech Specs and Const. Drawings, Relevant code/ standards | | SR | √ | |
| 10.03 | | DFT of paint - Over steel surface | As agreed / required | B | Physical | Each surface at random | Tech Specs and Const. Drawings | | SR | √ | |
| 10.04 | | Acceptance of painted surfaces | As agreed / required | B | Physical | Each surface at random | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| 11.00 | PERMANENT BOLTS AND NUTS AND WASHERS | | | | | | | | | | |
| 11.01 | | Material | As agreed / required | A | Physical and MTC Review | Once for each lot of delivery | Tech Specs and Const. Drawings | | SR/MTC | √ | Permanent mild steel Bolts, mild steel Nuts, Mild steel Washers, High strength structural Bolts, Washers-Dimensions, properties, storage along with MTC |
| 11.02 | | Contact surfaces before bolting | As agreed / required | B | Physical | Random before asembly for bolting | Tech Specs and Const. Drawings, IS 4000 | | SR | | |
| 11.03 | | Inspection of the assembled bolts | As agreed / required | B | Physical | Randomly in each shift for assembeled bolts | Tech Specs and Const. Drawings, IS 4000 | | SR | | |
| 11.04 | | Tensioning | As agreed / required | B | Physical | Randomly during snug tight test and after full tensinoning | Tech Specs and Const. Drawings, IS 4000 | | SR | √ | |
| 11.05 | | Acceptance of installed bolts | As agreed / required | B | Physical | Each bolt | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| 12.00 | STAINLESS STEEL HAND RAILS | | | | | | | | | | |
| 12.01 | | Material | As agreed / required | A | Physical/MTC Review(In case procured by contractor) | Once for each lot of delivery | Tech Specs and Const. Drawings | | SR/MTC | √ | Also check grade of steel |
| 12.02 | | DPT for welding | As agreed / required | A | Physical | Random for each fabrication | AWS D1.1 / 'Tech Specs and Const. Drawings | | SR/LB | √ | WPS shall be submited for Owner approval , electrodes used shall be as specified in WPS |

| LOGO | SUPPLIERS NAME AND ADDRESS: | INDICATIVE FIELD QUALITY PLAN | | | | | | ANNEXURE- V | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM : STRUCTURAL STEEL WORK | | QP NO. : | | 2 | PROJECT: | FLUE GAS DESULPHURISATION SYSTEM PACKAGE | | | |
| | | | | REV. NO .: | | 0 | PACKAGE: | | | | |
| | | SUB-SYSTEM : FABRICATION & ERECTION | | DATE : | | | CONTRACT NO. | | | | |
| | | | | PAGE : | | | MAIN CONTRACTOR | | | | |
| Sl. No | Activity and operation | Characteristics / instruments | | Class# of check | Type of Check | Quantum Of check | Reference Document | Acceptance Norms | Format of Record | | Remarks |
| 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | D* | 10 |
| 12.03 | | Acceptance of stainless steel hand rails | As agreed / required | B | Physical | Each installation | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| **13.00** | **PTFE SLIDING BEARINGS AND ELASTOMERIC BEARINGS** | | | | | | | | | | |
| 13.01 | | Material from approved source | As agreed / required | A | Physical and MTC Review | Once for each lot of delivery | Tech Specs and Const. Drawings | | SR/MTC | √ | |
| 13.02 | | Acceptance of installation of bearings | As agreed / required | B | Physical | Each installation | Tech Specs and Const. Drawings | | SR | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | **LEGEND: D *** Records, indentified with "Tick" (√) shall be essentially included by supplier in QA | | | | | | **DOC. NO.:** | **REV:** 0 | | |
| | | **Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB** | | | | | | | | | |
| **Manufacturer/ Sub-supplier** | **Main-supplier** | **Categorization Witnessing & Accepting (As per Owner QA&I System)**<br>**Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report,MfrTC = Manufacturer's Test Certificate** | | | | | **For Owner USE** | | | | |
| **Signature** | | This document shall be read in conjunction with Owner Tech. Specifications, BOQ, Drawings | | | | | | **REVIEWED BY** | **APPROVED BY** | | **APPROVAL SEAL** |

TENDER NO PSER:SCT:NBN-C2067:20

0-00-020-74481

ALL DIMENSIONS IN MILLIMETRES
















| REV. | DATE | ALTERED | S.Srinivasan |
|---|---|---|---|
| 07 | 22-08-2011 | CHD. & APPD. | G.Veeramani |

1. SPACE FOR ROUTING OF ASH HANDLING PIPES SHOWN NEAR 'M' ROW OF COLUMN AS PER DRG. NO. 0270-101-HYD-PVM-B-003/R3
2. APPROACH IO FLY ASH IOWER INDICATED FROM 'Q' ROW OF COL. AT EL.14500.
3. SPACE FOR CABLE TRAY & PIPE ROUTING SHOWN NEAR 'T' ROW OF COLUMN AT EL.6500

| REV. | DATE | ALTERED | S.Srinivasan |
|---|---|---|---|
| 05 | 10-01-2011 | CHD. & APPD. | G.Veeramani |

1. BOTTOM OF FLUE DUCT OPENING IN CHIMNEY REVISED TO EL 10500 AS PER NTPC'S EMAIL DATED 17-12-2010.
2. EL. OF DUCTING ENTERING CHIMNEY REVISED AS 14650 TO SUIT THE NEW DUCT OPENING ELEVATION.
3. DUCTING & SUPPORTS NEAR & INSIDE CHIMNEY REVISED TO SUIT THE NEW DUCT OPENING ELEVATION.
4. CHIMNEY OUTER RAFT DIA REVISED AS 42100.
THE ABOVE REVISIONS ARE AS PER NTPC LETTER NO.: CC:PE:0270:101:4706, DT. 21-12-2010.
& EMAIL DT. 17-12-2010.
5. TAPPING POINT FOR SOX&NOX MEASUREMENT AND ITS APPROACH FLOOR ADDED NEAR V1&W1 COLS.

| REV. | DATE | ALTERED | S.Srinivasan |
|---|---|---|---|
| 04 | 16-12-2010 | CHD. & APPD. | G.Veeramani |

1. BUFFER ASH TOWER SHOWN BETWEEN 'Q' & FIRST FIRST ROW OF ESP AS PER NTPC DRG.
2. THE BRACINGS BETWEEN COL. 'R' & 'T' AT EL.8000 CORRECTED AS PER BGTPP 3X250MW.
3. ELEVATION OF TRANSITION DUCT SHOWN IN VIEW 'Z'.

| REV. | DATE | ALTERED | S.Mohanraj |
|---|---|---|---|
| 03 | 09-01-2010 | CHD. & APPD. | G.Veeramani |

1. DISTANCE BETWEEN 'N','P','Q' & FIRST ROW OF ESP COLUMNS UPDATED TO ACCOMODATE ASH TOWER & VACUUM PUMPS.
THIS IS AS PER THE REQUIREMENT OF NTPC.

| REV. | DATE | ALTERED | T.Selvaraju |
|---|---|---|---|
| 08 | 20-04-2012 | CHD. & APPD. | G.Veeramani |

1. SCOPE OF MILL HANDLING COLUMNS BY BHEL MARKED IN THE KEY PLAN OF ID.SYSTEM.

| REV. | DATE | ALTERED | S.Mohanraj |
|---|---|---|---|
| 06 | 02-05-2011 | CHD. & APPD. | S.SV / G.V |

1. MILL REJECTS PIPE CORRIDOR SHOWN BELOW EL. 10000 AND BEFORE 'M' ROW.
2. FLY ASH TOWER LOCATION SHOWN NEAR 'Q' ROW.

| REV. | DA | ALTERED | S.Mohanraj |
|---|---|---|---|
| 02 | 30-1: | | G.Veeramani |

1. DISTANCE BETWEEN 'N' ROW TO FIRST ROW OF ESP COLUMNS REVISED FROM 22500 TO 24000.
2. DISTANCE BETWEEN 'Q' ROW TO FIRST ROW OF ESP COLUMNS REVISED FROM 7350 TO 8850.
3. DISTANCE BETWEEN LAST ROW OF ESP COLUMNS TO 'R' ROW OF COLUMNS REVISED FROM 6634 TO 5200.
4. DISTANCE BETWEEN LAST ROW OF ESP COLUMNS TO CL. OF ID. FAN REVISED FROM 24434 TO 23000.
5. DIMENSIONS & LOCATION OF DUCTING INSIDE CHIMNEY SHOWN.
6. DISTANCE BETWEEN 'U' & 'V' ROW COLUMNS REVISED FROM 8000 TO 7934.
7. DISTANCE BETWEEN 'CL OF ID FAN & CL OF CHIMNEY REVISED FROM 17000 TO 16934.
8. CL. EL OF CHIMNEY OPNG SHOWN AS 12675.
9. SIZE OF CHIMNEY OPNG SHOWN AS 8300X4650.
10. SPACE FOR ASH TOWER SHOWN BEFORE ESP.
11. ID.FAN UPDATED IN LINE WITH FAN DRG NO. 1-00-099-21645
12. LOCATION OF BUS DUCT AFTER ESP UPDATED.

| REV. | DATE | ALTERED | Damodar |
|---|---|---|---|
| 01 | 10-11-2008 | CHD. & APPD. | G.Veeramani |

1. ID.FAN UPDATED IN LINE WITH FAN ARRGT. DRG.
2. DUCTING BEFORE AND AFTER ID.FAN UPDATED.
3. DUCT EL. FROM FAN OUTLET IN VIEW 'Z' UPDATED.

NOTES: –

1. THIS DRAWING SHOULD BE READ ALONG WITH 0-00-020-74482
2. ALL DUCT DIMENSIONS ARE OF INSIDE SIZES ONLY.
3. ELBOW RADIUS IS 300mm UNLESS NOTED.
4. MANHOLE DOORS ARE SHOWN TENTATIVELY, THESE MAY BE LOCATED SUITABLY WHEREVER ACCESS FLOORS ARE AVAILABLE.
5. ALL ELEVATIONS REFER TO T.G. BUILDING FINISHED FLOOR LEVEL ±0.00M WHICH CORRESPONDS TO RL(+)127.5 M. BOILER AREA & ESP AREA FINISHED FLOOR LEVEL SHALL BE (-)200mm.

CUSTOMER NO. : 1200, 1201, 1202 & 1203

NTPC DRG. NO. 0270-101-01-TR-PVM-F-005

CUSTOMER: BHARTIYA RAIL BIJLEE COMPANY LTD., (BRBCL)
(A JOINT VENTURE COMPANY BETWEEN NTPC & MINISTRY OF RAILWAYS)

CONSULTANT: NTPC LIMITED

PROJECT: NABINAGAR THERMAL POWER PROJECT
( NTPP - 4 X 250 MW - UNIT - I, II, III & IV )
810 T/HR; 155 KG/SQ.CM(G); 540°C/ 540°C

BHARAT HEAVY ELECTRICALS LIMITED.,
BOILER PLANT UNIT; TIRUCHIRAPALLI-INDIA-620 014

| | NAME | SIGNATURE | DATE |
|---|---|---|---|
| DRAWN | S.Mohanraj | Sd... | 24-10-2008 |
| DESIGN | Damodar | Sd... | 24-10-2008 |
| APPROVED | G.Veeramani | Sd... | 24-10-2008 |

ALL DIMENSIONS IN MILLIMETRE

PROJECTION

SCALE 1:150

TITLE: LAYOUT OF ID SYSTEM ELEVATION

DRG.NO. 0-00-020-74481

REV. 08

CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHEL. IT MAY BE USED ONLY FOR THE PURPOSE FOR WHICH IT IS INTENDED AND MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

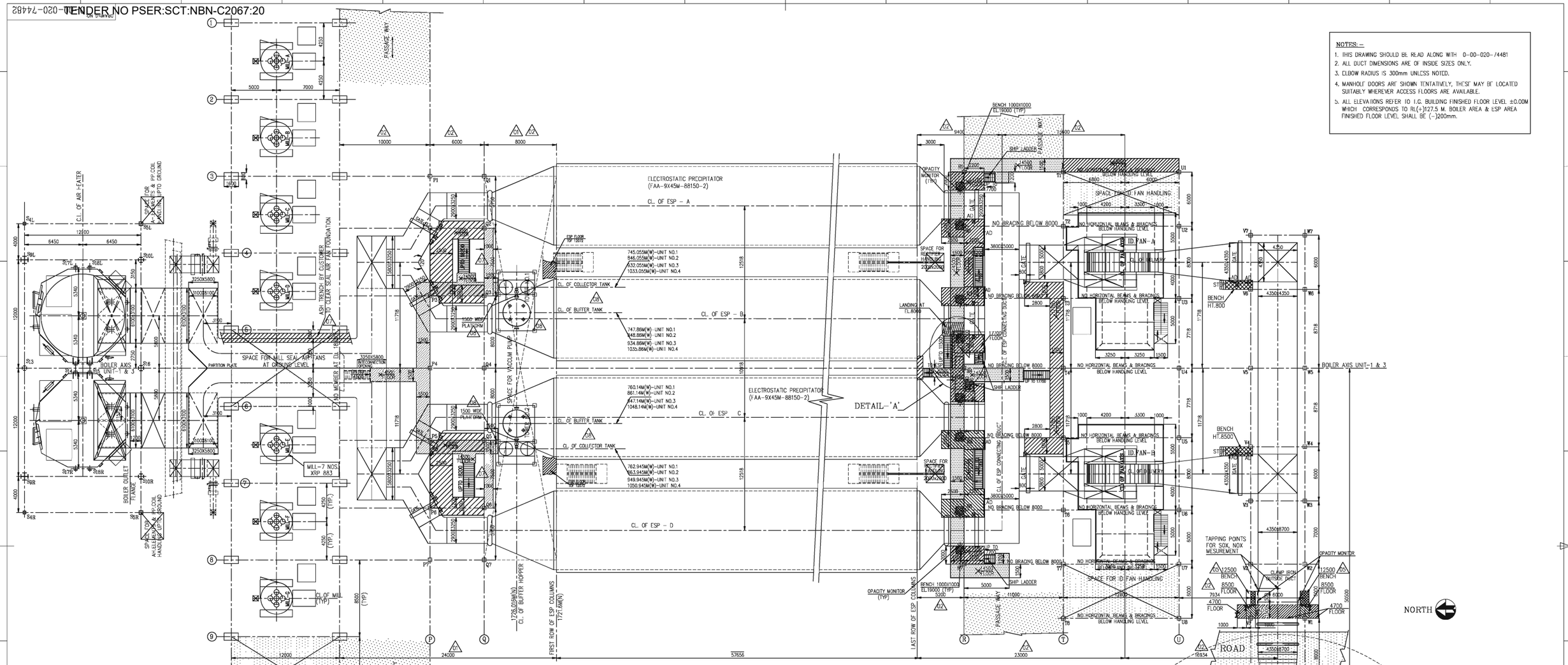
TENDER NO PSER:SCT:NBN-C2067:20

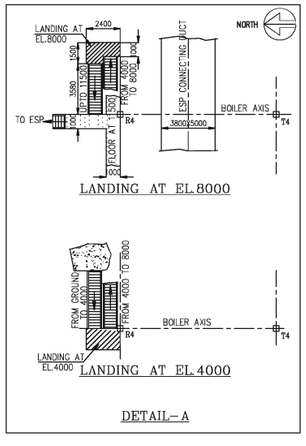
TENDER NO PSER:SCT:NBN-C2067:20

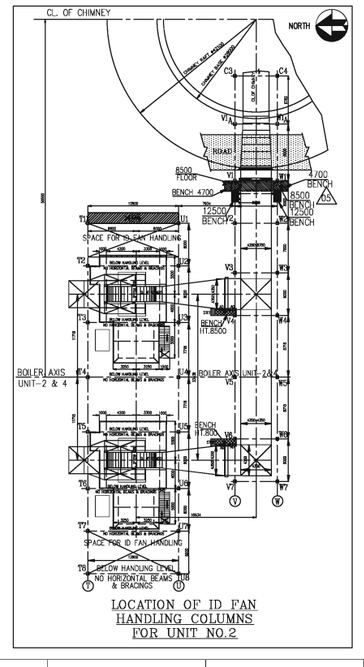
0-00-020-74482

NOTES:-

1. THIS DRAWING SHOULD BE READ ALONG WITH 0-00-020-74481
2. ALL DUCT DIMENSIONS ARE OF INSIDE SIZES ONLY.
3. ELBOW RADIUS IS 300mm UNLESS NOTED.
4. MANHOLE DOORS ARE SHOWN TENTATIVELY, THESE MAY BE LOCATED SUITABLY WHEREVER ACCESS FLOORS ARE AVAILABLE.
5. ALL ELEVATIONS REFER TO I.G. BUILDING FINISHED FLOOR LEVEL ±0.00M WHICH CORRESPONDS TO RL(+)127.5 M. BOILER AREA & ESP AREA FINISHED FLOOR LEVEL SHALL BE (-)200mm.




LOCATION OF ID FAN HANDLING COLUMNS FOR UNIT NO.2

| REV. | DATE | ALTERED | |
|---|---|---|---|
| 08 | 20-04-2012 | CHD. & APPD. | T.Selvaraju / G.Veeramani |

1. SCOPE OF MILL HANDLING COLUMNS BY BHEL MARKED.
2. 1500mm WIDE PLATFORM ADDED AS PER CUSTOMER REQUIREMENT NEAR COLUMNS Q3 & Q5.
3. LOCATION OF COLLECTOR TANK TOWER MARKED AS PER CUSTOMER KEY PLAN 0270-162-PVM-B-102-02.TIF

| REV. | DATE | ALTERED | |
|---|---|---|---|
| 07 | 22-08-2011 | CHD. & APPD. | S.Srinivasan / G.Veeramani |

1. FLY ASH TOWER APPROACH FLOOR ADDED IN BETWEEN COLS. Q2&Q3 and Q5&Q6.
2. ASH TRENCH BY CUSTOMER SHOWN NEAR SEAL AIR SYSTEM (NEAR MILL BAY COL ROW 5).

| REV. | DATE | ALTERED | |
|---|---|---|---|
| 06 | 02-05-2011 | CHD. & APPD. | T.Selvaraju / S.SV / G.V |

1. FLY ASH TOWER COLUMNS ADDED.
2. DIMENSION 9948 FOR FLY ASH TOWER LOCATION ADDED.
3. CHIMNEY INNER RAFT DIA CORRECTED AS ø3500

| REV. | DATE | ALTERED | |
|---|---|---|---|
| 05 | 10-01-2011 | CHD. & APPD. | T.Selvaraju / G.Veeramani |

1. TAPPING POINTS FOR SOX&NOX MEASUREMENT AND IT'S APPROACH FLOOR ADDED NEAR V1&W1 COLUMNS.
2. DUCT AT CHIMNEY ENTRY ALTERED FOR THE REVISED DUCT ROUTING WITH CL. OF ENTRY EL.14650.
3. CHIMNEY RAFT DIAMETER CORRECTED AS ø42100.

| REV. | DATE | ALTERED | |
|---|---|---|---|
| 04 | 16-12-2010 | CHD. & APPD. | S.Srinivasan / G.Veeramani |

1. BUFFER ASH TOWER SHOWN BETWEEN 'Q' & FIRST FIRST ROW OF ESP AS PER NTPC DRG.

| REV. | DATE | ALTERED | |
|---|---|---|---|
| 03 | 09-01-2010 | CHD. & APPD. | S.Mohanraj / G.Veeramani |

1. DISTANCE BETWEEN 'N','P','Q' & FIRST ROW OF ESP COLUMNS UPDATED TO ACCOMODATE ASH TOWER & VACUUM PUMPS.
THIS IS AS PER THE REQUIREMENT OF NTPC.
2. MILL BAY COLUMN ROW NUMBERS ADDED.

| REV. | DATE | ALTERED | |
|---|---|---|---|
| 02 | 30-12-2008 | CHD. & APPD. | S.Mohanraj / G.Veeramani |

1. DISTANCE BETWEEN 'N' ROW TO FIRST ROW OF ESP COLUMNS REVISED FROM 22500 TO 24000.
2. DISTANCE BETWEEN 'Q' ROW TO FIRST ROW OF ESP COLUMNS REVISED FROM 7350 TO 8850.
3. DISTANCE BETWEEN LAST ROW OF ESP COLUMNS TO CL. OF ID. FAN REVISED FROM 24434 TO 23000.
4. DISTANCE BETWEEN LAST ROW OF ESP COLUMNS TO 'R' ROW OF COLUMNS REVISED FROM 6634 TO 5200.
5. DIMENSIONS & LOCATION OF DUCTING INSIDE CHIMNEY SHOWN.
6. DISTANCE BETWEEN 'U' & 'V' ROW COLUMNS REVISED FROM 8000 TO 7934.
7. DISTANCE BETWEEN 'CL. OF ID FAN & CL OF CHIMNEY REVISED FROM 17000 TO 16934.
8. SPACE FOR ASH TOWER SHOWN BEFORE ESP.

| REV. | DATE | ALTERED | |
|---|---|---|---|
| 01 | 10-11-2008 | CHD. & APPD. | Damodar / G.Veeramani |

1. ID.FAN UPDATED IN LINE WITH FAN ARRGT. DRG.
2. DUCTING BEFORE AND AFTER ID.FAN UPDATED.

CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

CUSTOMER NO. : 1200, 1201, 1202 & 1203

NTPC DRG. NO. 0270-101-01-TR-PVM-F-004

CUSTOMER
BHARTIYA RAIL BIJLEE COMPANY LTD., (BRBCL)
(A JOINT VENTURE COMPANY BETWEEN NTPC & MINISTRY OF RAILWAYS)

CONSULTANT
NTPC LIMITED

PROJECT
NABINAGAR THERMAL POWER PROJECT
( NTPP - 4 X 250 MW - UNIT - I, II, III & IV )
810 T/HR; 155 KG/SQ.CM(G); 540°C/ 540°C

BHARAT HEAVY ELECTRICALS LIMITED.,
BOILER PLANT UNIT; TIRUCHIRAPALLI-INDIA-620 014

| | NAME | SIGNATURE | DATE |
|---|---|---|---|
| DRAWN | S.Mohanraj | Sd... | 24-10-2008 |
| DESIGN | Damodar | Sd... | 24-10-2008 |
| APPROD | G.Veeramani | Sd... | 24-10-2008 |

TITLE
LAYOUT OF ID SYSTEM PLAN

ALL DIMENSIONS IN MILLIMETRE
PROJECTION
SCALE 1:150
DRG.NO. 0-00-020-74482
REV. 08

TENDER NO PSER:SCT:NBN-C2067:20

| | | |
|---|---|---|
| Maharatna Company | **TITLE: - 4X250 MW BRBCL NABINAGAR FGD**<br>**SPECIFICATIONS FOR SINGLE FLUE RCC CHIMNEY** | SPECIFICATION NO. PE-TS-463-620-C002<br>VOLUME :<br>SECTION :<br>REV.NO. 00<br>SHEET |

# SECTION-C

# SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL WORKS

# SPECIFICATION NO. PE-TS-463-620-C002

**TECHNICAL SPECIFICATION FOR CHIMNEY(ELECTRICAL**

**SECTION-C**

# VOLUME – II

# SECTION-C

# SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL WORKS

Note : In case of any conflict between section-C & section-D of electrical portion, section-C of electrical portion shall prevail.

# TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

## 01.00.00 GENERAL

This specification lays down requirement of work for the Electrics to be executed on Chimney. The Bidder will include all such items of work which are essential to make the individual equipment/system complete in all respect and satisfactory completion of the proposed scheme irrespective of whether specifically mentioned here or not.

All equipment/ fittings will be easily approachable for maintenance/ replacement. Necessary platforms with handrails will be provided for maintenance of all the fittings/ equipment.

All equipment and accessories covered under this specification will conform to Technical Specification given in this document. The owner, however, reserves the right to accept or reject the proposal without assigning any reason.

All safety measures as required to be adopted as per the statutory regulations and the safety rules of the plant will be strictly followed by the Bidder during execution of the contract.

Supply, laying and termination of all the cables required for chimney elevator including trailing cable will be under scope of the Bidder.

## 01.01.00 Standards and Regulations

The electrical equipment / installation will comply with the requirements of the following Rules/regulations as amended up to date:

i) Indian Electricity Rules

ii) National Electrical codes and Indian standards

iii) International Civil Aviation Organization regulations

iv) National Airport Authority / DARA regulations

## 01.02.00 Ambient conditions

The entire electrical installation of the chimney will be suitable for an ambient temperature of 55 deg C since this temperature is likely to be encountered during service when the chimney is in full operation. The equipment will be suitable for operation in the rigorous weather conditions prevailing at the chimney.

# TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

## 02.00.00 SCOPE AND BRIEF DESCRIPTION OF WORK

The scope of work includes design, detailed engineering, procurement of items, shop testing, packaging, delivery to site, unloading at site, storage, handling, comprehensive insurance, erection, testing and commissioning of all necessary items for the chimney as indicated below.

1) Lightning protection system consisting of air termination, down rods/ GI strips, test points etc.
2) Main Power Distribution boards(PDB), Emergency distribution board, Elevator board, Lighting Panels, Power Panels etc. for power supply to various electrical items
3) Earthing system for equipment and structures of the chimney.
4) Aviation warning system.
5) Illumination of various platforms & landings of RCC chimney
6) Welding sockets, Power receptacles, switches and other hardware
7) Power and control Cables
8) Cabling system including trays, supporting structure, conduits etc.
9) Electrics for the freight cum passenger elevator and roll up door.
10) Accessories like clamps, nuts, bolts etc.
11) Under ground earthing for the earthing system as well as lightning protection
12) Communication system

The Bidder will provide change over facility in the DB

The successful Bidder will have to carry out the detailed engineering for the entire work.
For installation of fixtures etc., the Bidder will have to arrange tools, tackles, welding sets, pipe bending machine, cable crimping tools, IR megger, earth megger, tester etc.

The Bidder will be responsible for supply and fixing of all accessories required for installation of lightning protection equipment, aviation lighting system equipment, light fittings, distribution panel, electrics for the freight cum passenger elevator, elevator control panel, etc. at required places even though every individual item necessarily may not have been detailed out explicitly in the specification.

The main items in the scope will be as follows:

- AC distribution board
- Telephone handset

## TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

- Power & control Cables including incoming cables to the board
- Cable accessories like glands, lugs, clamps, brackets, JBs, ferrules and other fixing accessories
- Conduits of required sizes for protection of cables
- Air termination rods
- GI strips for lightning protection.
- GI strips for earthing of equipment & structures
- Earthing electrodes & Treated earth pits.
- Aviation warning lights
- 24 Hrs timer, Photoelectric light detector etc. for controlling the lights
- Outdoor type fittings and lamps
- Indoor type fittings for illumination of premises inside
- 20A and 63 A Power receptacles, 24V sockets etc.
- O & M spares and commissioning spares
- Special tools and tackles for the equipment/system supplied
- Complete electrics for the freight cum passenger elevator and for electrically operated door.
- Danger boards, safety items etc.
- Various fixing accessories such as nut bolts, check nuts, bushes, clips, nails, clamps, screws, hoppers, conduits, etc.

For lightning protection, Bidder scope of work will include supply, installation testing and commissioning of the complete system consisting of air terminations, down rods, earth, testing points, earthing pits, etc.

Bidder will furnish a detailed drawing of the lightning protection and earthing system and execution of work will be commenced only after obtaining approval to this from the owner.

For aviation warning system Bidder scope of work will include supply and installation & commissioning of the complete aviation warning system including supply & laying of cables, termination etc.

Aviation lighting system will be test operated by the Bidder for not less than 60 days. Equipment and work, which fails during the test period, will be repaired or replaced at the option of the owner.

The scope will also include the civil works associated with aviation lighting.

The Bidder will furnish a detailed drawing of aviation warning system and associated power distribution scheme and execution of work will be commenced only after obtaining approval to this from the owner.

For general illumination of chimney , scope of work includes installation of complete illumination system including distribution board, illumination fittings,

cabling, power receptacles, maintenance sockets, earthing etc.

The Bidder will also furnish a detailed drawing of illumination system and associated power distribution network.

02.01.00 **Power Supply System**

The details of power supply system are outlined below.

a) 415 Volt system (Normal)

| | | |
|---|---|---|
| i) | System voltage | 415 V +/-10%, three phase, 4 wire, neutral solidly earthed |
| ii) | System frequency | 50 Hz +/- 5% |
| iii) | Combined Voltage and frequency variation | 10% |
| iv) | Fault level | 50 KA |

b) 415 Volt system (Emergency)

| | | |
|---|---|---|
| i) | System voltage | 415 V +/-10%, three phase, 3 wire syatem |
| ii) | System frequency | 50 Hz +/- 5% |
| iii) | Combined Voltage and frequency variation | 10% |
| iv) | Fault level | 50 KA |

c) In case any power supply other than 415 V, 3 phase indicated above is required, same will be generated by the Bidder through suitable step down transformer, rectifier etc.

03.00.00 **TECHNICAL SPECIFICATION/DETAILS OF EQUIPMENT AND INSTALLATION**

03.01.00 **LIGHTNING PROTECTION**

The chimney will be protected against damage by the lightning protection system complying with IEC-62305 & latest IS standard,and will be subject to approval of the owner.

## TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

Around the top of each of the flue ducts, a coronal band of lead coated copper strip of size 50x6 mm or equivalent approved section will be provided. The circumferential conductor will be connected to the down conductors of minimum 50x6 mm size galvanized steel strips. The other end of each down conductor will be connected to an earth termination. Vertical down conductors will be spaced as per IEC-62305 & latest IS standard.

Vertical air termination will be of 2.5 m height and will be projecting 0.75 m above the highest part of the chimney. Air terminations will be equally spaced along the periphery at intervals of maximum 2.4 m.

The vertical air terminations will be made of minimum 20 mm dia solid copper rod with top with lead coating and will have spikes on solid sphere on top. The termination rod will be secured to the top of the chimney with adequate number of fasteners to withstand high wind pressure at the height involved.

The vertical air terminations will be electrically connected together with the lead coated copper strip coronal band which will be fixed 600 mm below top of the chimney . The coronal band will be clamped along the surface at intervals of 600 mm by 25x6 mm GI clamps. The connection between copper and GI will be done by brazing.

The down conductor will be clamped along the surface at intervals of 1500 mm by GI clamps. The connection between the GI Flats and GI clamps will be done by arc welding.

The down conductors will be minimum 4 numbers per flue ducts and will be evenly spaced along the periphery. These material provided at top of 12m shall have additional coating of 2mm thick seamless lead cover.
At each chimney platform level, a circulating band will be provided which will be made of 50 x 6 mm GI flat and electrically connected to each down conductor.

Earthing system for lightning protection will be electrically separate from the earthing of ladders, platforms, equipment and structures. Separate earthing systems will be provided accordingly.

Earth termination will consist of earth electrodes made of 3 Metre long MS rods driven into ground. The earth electrode will conform to IS: 3043. Test joint will be provided at a height of 1.0m from grade level for each down conductor before termination on earth electrode. The test point will be covered in 150 X 150 X 100 mm GI box. The testing point of the down conductors will be convenient for testing but inaccessible for interference. Testing point will be of phosphor-bronze gunmetal or copper. The down conductors will come via these test points to the earth pits. Sufficient earth electrodes will be provided to limit the earth resistance as per standards. No sharp bends will be formed in the down conductors and will be kept as straight as possible.

## TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

A suitable chamber having a water tight manhole cover of approved pattern and size will be constructed around each earth termination and will also house the joint between the earth termination and the down conductor.

Earth pit will consist of 40 mm dia 3000 mm long MS rod electrode in accordance with IS: 3043. These earth pits will be interconnected by providing a peripheral band of 40 mm dia MS rods to be laid at depth of minimum 600 mm below grade level. At least two pig tails each of 2 nos. 40 mm MS rod will be brought out one meter above ground to interconnect the Earth grid of RCC Biflue chimney with the main grounding grid. Interconnection will be done by the Bidder.

All connections clamps, anchors, etc. of the lightning protection system will be made of suitable galvanized steel fittings. All joints will be clamped or bolted by high-pressure contact or by phosphorus copper brazing of the metal to form a connection of adequate current carrying capacity and mechanical strength. Soldered connections will not be permitted.

All reinforcing bars will be properly bonded and connected to down conductors if the latter is taken along the wall of the structure.

The ohmic resistance of the lightning conductor system when isolated from earth electrode will be less than 1.0 ohm. The earth electrode resistance will also be less than 1 ohm when measured after disconnecting from plant grid.

The minimum number of earth pits will be eight, however, to achieve earth resistance value as described above, more pits will be provided.

The exposed conductors, connections, clamps, base plates, etc., will be protected by hot dip galvanizing. All site-welded joints in down conductors will be coated with anticorrosive paints over a coat of primer.

All metallic structures like ladders, handrails, light fixtures along with reinforcement bars will be bonded to the down conductors/circumferential conductor by GI strip of size not less than 50x6 mm either by welding or by bolting.

The down conductors on the base diagonal columns will be protected from mechanical damage for a height of 2.5 metres from the grade by taking them through cement pipe fixed on the face of the column, the pipe in turn filled with concrete of 1:5:10 nominal mix.

During the construction of the chimney, temporary lightning protection will be maintained by connecting the reinforcement bars to two earth electrodes by means of two 50x6 mm GI conductors. Temporary protection will be provided even after the completion of the tower till such time that the permanent air

## TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

termination rods are installed.
Interconnection of earth pits will be done by bolting so that earth resistance of individual earth pits can be measured.

Separate earthing systems will be considered for lightning protection and for equipment/structure earthing.

03.02.00 **AVIATION WARNING SYSTEM**

The aviation warning system lights will meet the regulations of ICAO, National Airport Authority.

The aviation warning lights will be clustered type LED.

The aviation warning system will be of High intensity flashing white LED

Aviation warning light will have Integral flasher & intensity control and latched lid for easy flashtube replacement. It will have three auto switched intensities - day / twilight and night.

The aviation warning lights will be controlled through photo electric control unit. Photo electric controller will be housed in a rugged, weather tight, IP 65, enclosure. LEDs will be provided to indicate the operation status of the unit. A bypass manual switch will be provided to bypass the photoelectric device, whenever required. Aviation warning light will have a day time effective intensity

Aviation obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organization (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA). The type of aviation obstruction lighting system shall be of high intensity aviation obstruction lights having an effective intensity of 2000 to 200,000 cd (minimum) depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 200000 cd. The intensity of lights shall be 20000 cd ± 25% at twilight and shall reduce automatically to a night time intensity of 2000 cd ± 25% through the use of photocell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc.

The system will be suitable for operation on 240V +/- 10%, single phase, 50 Hz, AC supply. Emergency supply shall feed aviation obstruction lighting.

Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at
locations and levels specified elsewhere. Suitable provision for approach to the AWL
shall be provided at the platform level. AWL shall be located at about 1-1.5 metre
above the top of platform to enable easy handling for maintenance.
The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments.

## TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

The body of the aviation light will be made of corrosion resistant aluminium casting finished in stove-enameled aviation yellow. The fittings will be complete with double compression type cable glands.

Aviation lights supports etc. will be fitted to the chimney by GI nuts on to GI inserts projecting from concrete surface. All bolts clamps etc used will be hot dip galvanized.

All the aviation light fixtures will be weatherproof and outdoor type suitable for highly humid and flue laden atmosphere.

The aviation light circuits will be distributed among R,Y and B phases of 3 phase, 4 wire supply.

1100 V grade, cable as per Electrical BOQ PVC insulated, heat resistant, steel wire armoured cable conforming to IS-1554 (Part-I) will be used for wiring the aviation warning system. The cable will be clamped by the side of the ladder at 750 mm centers by means of GI clamps.

Weather proof terminal boxes with cable glands made of brass, tin plate will be provided at the location of each of the aviation warning lights for termination of cables.

Temporary warning lights will be installed during construction suitably located above the top most point of obstruction and will be shifted up as the construction progresses. These lights need be installed only after the level of obstruction is greater than 40 m above the graded level.

Temporary warning lights will be four fixtures each with not less than 10 candelas of red light. As construction progresses, each completed level will be provided with temporary aviation warning lights. Temporary obstruction lights will have four fixtures located in a horizontal plane on the chimney structure to ensure unobstructed visibility of at least one obstruction light from aircraft at any normal angle of approach. Power for operation of the temporary lights will be obtained from the construction Power system. Supply circuits for these lights will be furnished, installed and maintained by the Bidder. These lights will be operated right from sunset to sunrise on each day of the contract period until the normal aviation warning system is commissioned and put to operation.

**TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)**

**SECTION-C**

The Bidder will provide sufficient hand railing, ladders, and platforms to attend any maintenance work.

03.03.00 **POWER DISTRIBUTION BOARD (PDB) / ACDB**

Distribution board will be of metal enclosed , single front, Indoor, floor mounted, free standing , fixed type conforming to IS: 13947 Part-1. The elevator board / power panels/Lighting panel will be of floor/wall mounted type. The equipment will be fully assembled and wired, complete with base frame, anchoring arrangement, gland plates, internal wiring, terminal blocks etc. Operating height of switches will be limited to 1800 mm.

Boards will have IP 52 enclosure.

PDB/AC Distribution Board (DB) will house SFU
modules only. They will have duplicate incomer with bus coupler.

Will have base channel of size ISMC 75.

Will have isolated busbar chamber for main busbar at the top, running through out the length of the board. Chamber will have removable cover.

Cable alley will have sufficient space for aluminium power cables and bottom cable chamber will be left free completely isolated from the vertical busbar.

Busbars will have same cross section through out the length. Rating of the neutral busbar will be 50% of the main busbar. Earth bus bar will run in bottom chamber throughout the length of the panel.

Bus bars and jumper connections will be of high conductivity aluminium alloy/copper.

Temperature rise of busbar and contacts when carrying rated current will not exceed 45 deg C with silver plated joints and 35 deg C with other type of joints over an ambient of 55 deg C..
All busbars will be adequately supported by non-hygroscopic, non-combustible track resistant and high strength sheet moulded compound or polyester fibre glass moulded insulators.

20% of the total feeders will be kept as spare.

The front of the feeder compartments will have hinged door with locking facility.

## TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

The incoming SFU unit of the Emergency board will be changeove
type and will have provision for two incoming supplies(one from emergency and one from normal). Autochangeover scheme shall be provided to enable changeover to healthy source on the failure of supply the incoming switch .

The board will be painted with one coat of zinc chromate primer (yellow) and two coats of synthetic enamel paint of approved shade.

DB will have indicating meters in the incoming feeders. Ammeter and voltmeter selector switches will be of rotary type with four stay put positions with adequate number of contacts for 3 phase 4 wire system.

All indicating meters will be flush mounted on panel front. They will be of at least 96 mm square size with 90 deg scales and will have an accuracy class of 2.0 or better.

Current transformers will be completely encapsulated epoxy resin insulated type having accuracy class of 1.0 conforming to IS 2705.

DB will have indicating lamps. Indicating lamps will be of the panel mounting, low wattage type. Lamps and lamp covers will be easily replaceable from the front of the panels.

Wiring for power circuits will be through 1100 V grade, copper wires of 2.5 sq mm size.

All internal control wiring will be through 660V grade, single core, 1.5 sq mm or larger stranded copper wires.

All panels will have continuous earth bus of minimum 50 x 6 mm size.

**Lighting Circuits**

Lighting panels will receive power from the power DB through lighting transformer for reducing the fault level. Lighting transformers will be dry type, natural air cooled with class F insulation or better. +/- 5% taps will be provided in steps of 2.5%. In case the transformer is not mounted inside the DB, same will be mounted in a separate enclosure with IP 42 degree of protection. However transformer terminal box will have IP-52 degree of protection.

**TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)**

**SECTION-C**

Miniature Circuit Breakers (MCB) will be used for the lighting circuits. They will conform to IS 8828.They will be current limiting type with magnetic and thermal release suitable for manual closing and automatic tripping under fault condition. MCBs will have interrupting capacity of 9 KA rms. MCB terminal will be shrouded to avoid accidental contact.
Different circuits will be used for aviation warning lights and general lighting. Various lights will be grouped in to different circuits and will be controlled through Miniature Circuit Breakers (MCBs) of adequate rating. MCB feeders will be provided for power receptacles and instrument supplies also. 20% of the MCBs will be kept as spare. Distribution board will be installed at a convenient operating height of 1.5 mtr from floor level. Supporting structure of the DB will be grouted properly. The distribution board will be supplied with tinned brass glands and tinned crimping type copper cable lugs for termination of cables. The DB and the entire installation will be earthed as per IS 3043 and electricity rules.

03.04.00 **GENERAL ILLUMINATION**

Adequate illumination will be provided at various platforms, stairways, landings etc.

The following average illumination levels will be maintained at different locations:

a) On equipment : 150 Lux
b) General platform area : 70 Lux
c) Stairways and landings : 100 Lux

Minimum one fitting will be provided on each landing.

80% of lighting at various platforms and 50% lighting in staircases will be fed from normal AC source and balance from Emergency AC source. Emergency AC supply will be obtained from Emergency Distribution board.

Following type of fixtures will be used:(Min 1 Fixture at each landing)

a) LED /HPSV well glass fixture dust tight(for platforms)
b) Energy efficient lamp fixture (for staircase)
c) Dust tight well glass fixture for internal light at each floor.
d) Street light type fixture ( for area illumination, illumination at 0.0 level etc.)

General illumination will be controlled by 24 hrs timer.

General illumination of the RCC chimney will be done for platform lighting with industrial weather proof dust tight with reflector integral mounted control gear

## TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

with LED lamps mounted on brackets on the platform hand rails on fabricated MS angle support

Number of light fittings for platform lighting provided on each platform level will be four. These fittings will be equally spaced on the platform outside the chimney at each level. Two fittings will be fixed to the ladder near access doors at each level. Lights will be operated through switches, outdoor duty type, located on the platform.

Light fixtures will have IP-55 enclosure.

The fittings will be fixed on hand railing of the platform such that they can be capable of withstanding high wind pressure.

General lighting system of chimney will be fed from a separate feeder of distribution board.

Considering voltage drop, 1100V, cable as per Electrical BOQ
armoured, PVC insulated, heat resistance cable conforming to IS:1554(part-I) will be used for wiring all lighting fixtures and power receptacles. The cable will be clamped by the side of the ladder at 750 mm centers by means of GI clamps.

Lighting fixtures, conduits, junction boxes etc. will be properly earthed using galvanized iron wire of 8 SWG. Earth wire will run inside along the entire length of conduit between the fixtures and distribution panel where it will be connected to the earth.

Heavy duty metal clad, welding receptacles rated for 415 V, 63 A will be provided at each internal platform level. Welding receptacles will have IP 55 degree of protection. The receptacle unit will be compete with 63A, AC 23 category switch, plug top and safety lid.

The welding receptacle will be wall mounted type. It will be interlocked such that

a) Switch can be put ON only when the plug is fully engaged

b) Plug can be taken out only when the switch is in OFF position.

c) Cover can be opened only when the switch is in OFF position.

Two nos. 20A, 240V, AC 3 pin industrial type power receptacles with controlling switches and loose matching plugs mounted in a weather proof and dust tight boxes will be supplied and installed at each of the platforms near access doors. The box will be fabricated of galvanized sheet steel having suitable hinged door properly gasketted to make it dust proof.

The lighting fixtures and receptacles will be fed such that loading of all the three

phases is balanced. The lamps on the same vertical line will be fed from different phases, so that failure of any one phase will not cause total blackout on one side.

**WIRING ARRANGEMENT AND INSTALLATION FOR ILLUMINATION WORK**

For aviation warning system two independent and separate circuits will be laid along the ladder inside the chimney and will come out through the access door to the outside platform . Cable as per Electrical BOQ will be laid for this purpose. At each platform a junction box will be provided for taking connection through MCB. Junction box at a platform will be looped with the junction box at next higher platform. The two circuits will be diametrically opposite of the chimney. At ground level in aviation lighting circuit contacts of the contactor will be provided to monitor the aviation lights. The contactor will be operating through a suitable timer/ photoelectric device which is mounted at the bottom on the distribution board. In case of malfunction of timer/ photoelectric device, manual bypass arrangement through bypass switch will be provided.

Similarly for platform lighting two independent circuits will be laid along the stairs at each platform junction boxes will be provided for taking connection through MCB to light fittings. From the junction box, cable will be connected to another junction box located at higher elevation. as per Electrical BOQ
cables will be laid for this purpose. From each circuit at each platform two separate sub circuits will be provided, one for platform level lighting and one for sockets.

Wiring installation covers supply and wiring of all the conduits, junction boxes, wires, accessories, cable identification tags/ferrules, hardware and consumables required to complete the installation.

All the cables and conduits will be clamped in steel supports fixed to the wall. Necessary dash fasteners will be provided by the Bidder for this purpose. The conduits will be supported at 750 mm intervals. The wiring will be continuous without any loose joints. Whenever looping or connection is to be made on wires, it will be done within the junction box through suitable fixed terminal strips. For longer run of conduits, pullout boxes will be provided at an interval of 4 m. Separate conduit will be used for individual phases.

All conduits will be electrically continuous and thoroughly grounded by drawing 8 SWG GI wire along the conduit.

The Bidder will install weather proof terminal boxes with MCBs and cable glands on each platform of the chimney at location close to the aviation warning beacons. The maximum conduit fill will not exceed 60%. Suitable pull boxes will be provided at convenient locations. All aviation light fixture, conduits and junction boxes etc. will be properly earthed. Earth wire will run inside along the entire length of conduit between the fixtures and distribution board where it will

be connected to earth.

Cables will be protected with GI pipes wherever there is a chance of mechanical damage.

03.05.00 **Cables**

Power cables will be 1100V grade, multi core, FRLS HR PVC or XLPE insulated, PVC sheathed, steel wire or steel strip armoured, stranded copper or aluminium conductor conforming to IS-1554.

Control cables will be 1100V grade, multi core, FRLS HR PVC insulated, PVC inner sheathed, steel wire armoured, PVC outer sheathed, stranded copper conductor conforming to IS-1554.

Following factors will be considered in sizing of cables:

a) Continuous current carrying capacity
b) Short circuit capacity
c) Voltage drop
d) Ambient temperature (55 deg C)
e) Cable grouping factors

Maximum voltage drop between main DB and the final equipment will be imited to 3 % when carrying full load current.

All cable sizing calculation will be submitted for approval.

Minimum size of cable will be 2.5 sq mm for copper and 6 sq mm for Aluminium.

**03.06 Installation**

Equipments/items will be installed in a neat manner so that it is leveled, plumbed, squared and properly aligned and oriented.

The Bidder will furnish all supervision, labour, tools, equipment, rigging materials, incidental items such as bolts, wedges, anchors/angles, frames, studs, rawl plugs, concrete inserts etc. required to completely install, test, adjust and fix the equipment.

Manufacturer's drawings, instructions and recommendations will be correctly followed in handling, erecting, testing and commissioning of all items/equipments and care will be exercised in handling to avoid distortion to stationary structures, the marring of finish, or damaging of delicate instruments or other electrical parts. All care should be taken to avoid damage of galvanised/painted surfaces during installation. All damaged surfaces of galvanised or ungalvanised faces of steel structures, conduits, junction boxes,

trays etc. will be brushed up and will be painted with red primer paint followed by two coats of aluminium paint/enamel paint to the satisfaction of Engineer.

Connections between distribution boards, between distribution board and Elevator board/lighting & power panels and between distribution board/power panels & receptacles will be carried out with FRLS-HRPVC or XLPE insulated armoured copper / aluminium cables. Connections between lighting panel and lighting fixture/ receptacles and for aviation lighting system will be carried out with PVC insulated copper / aluminium wires laid in galvanised steel conduit.

After installation of lighting fixtures/ receptacles/switch boxes, the panel number and circuit number will be painted on them at a suitable place.

Wherever non-galvanised steel members/structures are erected, they will be brushed before giving one coat of lead primer followed by two coats of epoxy paint. All nuts, bolts and washers required for complete installation will be hot dipped galvanised.

Wooden plugs in walls and ceilings for fixing of lighting fixtures and accessories are not acceptable. A suitable fool-proof method (preferably using dash fasteners) for fixing these will be offered and this will be subject to Owner's approval.

To distinguish emergency AC fixtures from normal AC fixtures, red painted circular mark of 1 cm. dia. will be provided on emergency fixtures

Exposed conduits will run in straight lines. Conduits will be fixed by using metallic saddles/clamp secured to suitable nylon rawl plugs with screws or secured to the wall/structure at an interval of not more than 1 metre. Notwithstanding the above in case of couplers or similar fittings, saddles/clamps will be fixed at a distance of 30 cm from the center of such fittings.

All openings in the floor/wall/ceiling etc, made for conduit installation will be sealed and made water proof.

For long conduit runs pull out boxes will be provided at suitable intervals (not exceeding 4 m to facilitate wiring. However pull out boxes need not be provided wherever junction boxes exists in circuit.

The entire metallic conduit system whether embedded or exposed will be electrically continuous and thoroughly grounded. Where slip joints are used, suitable bonding will be provided among the joint to ensure a continuous ground circuit. G.I. Pull wire of adequate size will be laid in all conduits before installation.

Each conduit run will be marked with its designation as indicated on the drawings. Identifications will be marked by means of painting so that each run of conduit is readily identified at each end. Where conduits terminate at panels, switch boxes, junction boxes, or other enclosures, the designations will also be

painted on the inside of the enclosure adjacent to the conduits.

Wires will not be pulled through more than two equivalent 90 deg bends in a single circuit run. Wherever required, suitable conduit junction boxes/pull boxes will be provided. All types of wiring, concealed or unconcealed will be capable of easy inspection

Receptacles and lighting circuits will be fed from different circuits. The switch controlling these circuits will be on the live side (phase wire) of the circuits

A.C. normal & AC emergency wiring will run throughout, in separate conduits. Wires of different phases will run in different conduits

Wiring will be spliced only at junction boxes. Maximum two wires will be connected at each terminal. In vertical run of wires, in conduit the wires will be suitably supported by means of hard rubber plugs, at each pull/junction box

Cables will be installed on trays/troughs or cleated to steel work. Cable trays/ troughs and supports will be prefabricated and hot dip galvanised. Cable trays/ troughs will be of ladder/ perforated type constructed of minimum 2mm thick mild steel

Cable tray/trough supports will be fixed by bolting in case of concrete structures and by welding in case of steel structures. Cable trays will be adequately fastened to supports. Cables will be cleated/clamped with cable tray/ trough on vertical runs at every 1 metre interval. Cables laid on horizontal runs will be secured to trays with nylon cable ties at every 5 metre interval.

Wherever cable passes through floor/wall, pipe sleeves will be provided and will be properly sealed after laying cable. No joints will be allowed in any cable run. Power and control cables will not be laid together. Cable tags will be provided on all cables at each end, on both sides of floor/wall crossings and at every 20 metre interval in cable tray runs.

**Electrics for Roll up Door**

The Bidder will include all necessary Electrics including electric drive, starter panel consisting of isolator , contactor , overload relay, On/Off push button , wiring etc.

Starter panel will be of IP54 enclosure and all components will be approved make only.

Types of cables and glands will be used as per details given in earlier clauses.

Incoming power supply will be taken from distribution board.

## 04.00 LIST OF MAJOR APPLICABLE CODES FOR ELECTRICAL EQUIPMENT

## TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)

**SECTION-C**

| | | |
|---|---|---|
| Protection against lightning | : | IEC-62305 & latest IS standard. |
| Earthing | : | IS-3043 (1991) |
| Aviation warning lighting | : | IS-4998 (1992) |
| Dust proof electric lighting fittings | : | IS-4012 (1990) |
| Switches | : | IS-13947 (1993) |
| Elevator motor/main control panel | : | IS-325 / IS-4722 |

Communication system

Communication system comprising of telephone socket at every internal platform level and at grade level,necessary wiring installation ,a telephone handset,junction boxes etc shall also be provided.Telephone cables shall be of mimimum 0.6mm diameter annealed high conductivity elecro copper conductor,PVC insulated,twisted,PVC tape wrapped,screened,rip corded,PVC sheathed,conforming to relevant ITD(Indian telephones department)specifications.

All equipment to be supplied shall be of type tested quality.The contractor shall submit for owner's approval the reports of all type tests as listed below:

(A) Distribution boards/panels-degree of protection tests

(B)aviation lights:

1)Intensity test

2)degree of protection test

Rack & Pinion Elevator

Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system.Emergency supply shall feed the elevator load

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

## ELEVATORS (ELECTRICALS)

1.00.00 **CODES AND STANDARDS**

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

**IS:4722, IS:325**

2.00.00 **Electric motor:**

The driving motors shall conform to I.S 325 and suitable for the Variable Voltage Variable Frequency (VVVF) application. All motors shall be squirrel cage induction type, suitable for operation at 415V (+/- 10% variation) , 3 phase, 3 wire, 50HZ (+3% to -5% variation) supply. Motors shall be provided with **thermal class 130 (B) or better insulation**

3.00.00 **CAR ELECTRICAL ACCESSORIES**

The following accessories shall be provided :

i) LED light fittings for illumination level of 100 lux on car floor.

ii) Portable light and alarm bell with battery and charger ventilation fan with control.

iii) Car control station with position indicator inside the car and at landing platforms ( both visual and audio).

iv) Emergency stop switch.

v) 5/15A, 3 pin plug socket with switch on top of lift car.

vi) Hand free speaker telephone set connected to plant network.

vii) AUTOMATIC RESCUE DEVICE (ARD)-(BATTERY DRIVE) :

Contractor to provide a modern Advanced electronic drive system of "RESCUING Passenger Trapped in a ELEVATOR".

viii) EMERGENCY SAFETY DEVICES :

The lift shall be provided with safety Device attached to the lift car frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car.

4.00.00 **OPERATIONAL REQUIRMENTS:**

a. Contractor shall provide car operating panel with luminous buttons, car position indication in car (both visual and audio) combined with direction arrows, overload warning indicator, battery operated alarm bell and emergency light and fan & hands free speaker telephone set with suitable battery, charger & controls.

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | b. Contractor shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio & visual).<br><br>c. Contractor shall provide electronic door detector ( Infra red curtain type).<br><br>d. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the Contractor.<br><br>e. For facilitating the movement of visually & hearing impaired persons, hall lantern and car arrival chimes shall be provided<br><br>f. All fixtures shall be in stainless steel face plates.<br><br>g. Push buttons shall be fixed in the car for holding the doors open for any length of the time required.<br><br>h. All other safety/protection/operation interlocks as required by IS:14665 (latest edition). |
| 4.00.00 | **POWER SUPPLY**<br><br>Each elevator shall be provided with a separate three phase, three wire 415V feeder of adequate rating |
| 5.00.00 | **Controls:**<br><br>The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation . Suitable control panel shall be provided in the machine room. |
| 6.00.00 | **Cables and wiring:**<br><br>All the cables except trailing cables shall be as per IS:1554-1 or IS-7098-I. the PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties.<br><br>a) Oxygen index of min. 29 (as per IS:10810 Part-58)<br>b) Acid gas emission of max. 20% (as per IEC-754-I).<br>c) Smoke density rating shall not be more than 60% (as per ASTMD-2843).<br><br>The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated ) or IS-4289 Part-II (PVC insulated). The flat type trailing cables if offered shall be in accordance with IEC-60227-6.<br><br>All wiring / cabling between the equipments in the lift machine room and that between the machine room and equipments in the lift well and at the landings shall be wired in HDP conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used. |
| 7.00.00 | **Earthing:**<br><br>The elevator structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043. |

## ANNEXURE-A
## CHARACTERISTICS OF OBSTACLE LIGHT (As per ICAL, Chapter -6 )

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Light Type | Colour | Signal Type/ (flash rate) | Peak intensity (cd) at given Background Luminance | | | Vertical Beam Spread ( C ) | Intensity (cd) at given Elevation Angles when the light unit is leveled (d) | | | | |
| | | | Above 500 cd/m² | 50-500 cd/m² | Below 50 cd/m² | | -10° (e) | -1°(f) | ±0°(f) | +6° | +10° |
| Light-intensity, Type A (fixed obstacle) | Red | Fixed | N/A | 10 mnm | 10 mnm | 10° | – | – | – | 10mnm (g) | 10mnm (g) |
| Light-intensity, Type B (fixed obstacle) | Red | Fixed | N/A | 32 mnm | 32 mnm | 10° | – | – | – | 32mnm (g) | 32mnm (g) |
| Light-intensity, Type C (Mobile obstacle) | Yellow/Blue (a) | Flashing (60-90 fpm) | N/A | 40 mnm (b) 400 max | 40 mnm (b) 400 max | 12° (h) | – | – | – | – | – |
| Light-intensity, Type D Follow-me Vehicle | Yellow | Flashing (60-90 fpm) | N/A | 200 mnm (b) 400 max | 200 mnm (b) 400 max | 12° (i) | – | – | – | – | – |
| Medium-intensity Type A | White | Flashing (20-60 fpm) | 20,000 (b) ± 25% | 20,000(b) ± 25% | 2,000(b) ± 25% | 3° mnm | 3%max | 50%mnm 75% max | 100%mnm | – | – |
| Medium-intensity Type B | Red | Flashing (20-60 fpm) | N/A | N/A | 2,000 (b) ± 25% | 3° mnm | – | 50%mnm 75% max | 100%mnm | – | – |



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**TECHNICAL SPECIFICATION FOR CHIMNEY (ELECTRICAL)**

**SECTION-C**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Medium-intensity Type C | Red | Fixed | N/A | N/A | 2,000 (b) ± 25% | 3° mnm | – | 50%mnm 75% max | 100%mnm | – | – |
| **High-intensity Type A** | **White** | **Flashing (40-60 fpm)** | **200,000 (b) ± 25%** | **20,000 (b) ± 25%** | **2,000 (b) ± 25%** | **3°-7°** | **3%max** | **50%mnm 75% max** | **100%mnm** | **–** | – |
| High-intensity Type B | White | Flashing (40-60 fpm) | 100,000 (b) ± 25% | 20,000 (b) ± 25% | 2,000 (b) ± 25% | 3°-7° | 3%max | 50%mnm 75% max | 100%mnm | – | – |

**Table 6.3. Characteristics of obstacle light**

Note: - This table does not include recommended horizontal beam spreads. 6.3.22 requires 360º coverage around an obstacle. Therefore, the number of light needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) See 6.3.25
b) Effective intensity, as determined in accordance with the Aerodrome Design Manual, Part4.
c) Beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the intensity shown in columns 4.,5and 6. The beam pattern is not necessarily symmetrical about the elevation angle at which the peak intensity occurs.
d) Elevation (vertical) angle are referenced to the horizontal.
e) Intensity at any specified horizontal radial as a percentage of the actual peak intensity at he same radial when operated at each of the intensities shown in columns 4, 5and 6.
f) Intensity at any specified horizontal radial as a percentage of the lower tolerance value of the intensity shown in columns 4, 5 and 6.
g) In addition to specified values, light will have sufficient intensity to ensure conspicuity at elevation angle ±0º and 50º.
h) Peak intensity should be located at approximately 2.5º vertical.
i) Peak intensity should be located at approximately 17º vertical.

## TECHNICAL SPECIFICATION FOR CHIMNEY(ELECTRICAL

## SECTION-C

**DRAWINGS, DATA AND MANUALS**

1. **To be submitted with the Bid**

1.01.01 Typical general arrangement drawing of Chimney showing location of lighting fixtures, lightning protection system, grounding system etc.

1.01.02 Typical general arrangement drawing of A.C. distribution board, lightning board.

1.01.03 Catalogue cuts of various types of lightning fixtures, major components, cables, conduits etc

1.01.04 Type Test Certificate of various equipment

2. **To be submitted for Approval (A) / Reference (R) and subsequent Distribution**

2.02.01 Dimensional general arrangement drawing of chimney showing disposition of aviation warning lights, interior lights on platforms and stairs, receptacles, A.C. distribution boards, lighting boards including their fixing arrangements (A).

2.02.02 Arrangement drawings for lightning protection and grounding system (A)

2.02.03 Single line drawing of A.C. distribution boards and lighting boards (A)

2.02.04 Cable and Conduit layout (A)

2.02.05 Technical data sheet of all equipment / components (A).

2.02.06 Instruction Manuals and Catalogue cuts of all equipment (R)

The manuals shall clearly indicate the method of installation, check-up and tests to be carried out before commissioning of the equipment.

2.02.07 Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.

2.03.00 The Contractor may note that the drawings, data and manuals listed are minimum requirement only. The Contractor shall ensure that all other necessary information required to fully describe the equipment / system offered are submitted with his Bid.

# SECTION-C

# SPECIFIC TECHNICAL REQUIREMENTS FOR CHIMNEY ELEVATOR

# SPECIFICATION NO. PE-TS-463-620-C002

# SECTION - C
# SUB SECTION – A6

# STACK ELEVATORS

## 1. SYSTEM DESCRIPTION

1.1 The Rack and pinion type stack elevator is required for installation inside multi-flue or outside single flue chimney. The stack Elevator is normally used for the movement of the maintenance personnel and for materials such as refractory bricks, etc. for maintenance of chimney.

## 2. SCOPE OF SUPPLY AND SERVICES

2.1 The scope of supply and services covered under the specification are broadly described below:

2.1.1 Four (4) Nos. Rack and Pinion type stack elevator complete with all other accessories and associated steel work.

2.1.2 Drive motor and control panel for Stack elevator

2.1.3 Control Panel

2.1.4 Equipment earthing

2.1.5 All power and control cables, trailing cables

2.1.6 Limit switches

2.1.7 Over speed governor

2.1.8 Alarm push button in the cage connected to battery operated alarm at elevator base.

2.1.9 Reverse phase relay connected to prevent operation of the cab with improper phase rotation or failure in any phase of power supply.

2.1.10 Continuous duty electrical torque motor recoil cable reels or cable trolley or any equivalent arrangement to maintain electrical power service to all electrical components of the elevator for complete travel of stack elevator.

2.1.11 One auxiliary panel shall be provided and mounted on the graded level enclosure equipped with a main ON-OFF selector switch, main contractor, breaker, relays, control transformer and fuses, tone frequency transmitter or equivalent arrangement, terminal blocks and all other accessories required for normal operation of the elevator.

2.1.12 One main control panel shall be furnished and mounted on top of the cab. Panel shall be in enclosure equipped with necessary equipment like rectifier, battery charger charger, tone frequency receiver, contactors, breakers, control transformer and fuses, thermal overload relays, and all other equipment and accessories required for normal operation of the elevator.

2.1.13 Cab shall be controlled by semi-automatic floor selection control system. Cab shall be furnished with 240 V grounding receptacle, emergency alarm push button with normally open contact, indicating light, limit switches, and all other necessary control devices required to ensure safe and continuous cab operation. One trailing cable shall connect the main control panel to aux. Panel at ground level. Cable shall supply the cab necessary power supply requirements. Cable guides shall be installed at every 6 m intervals to avoid entanglement of this cable. Control signal between the aux. Panel at ground level, the main control panel on the cab and the landings shall be provided with tone frequency receiver or any other equivalent arrangement by trailing control cable.

2.1.14 Each landing assembly shall include a limit switch and push button control station installed and wired to a landing junction box.

2.1.15 All power cable and race way shall be provided and installed by the bidder for interconnection of the main control panel, auxiliary panel and landing junction boxes. Trailing cables shall be as per relevant IS/IEC standard.

2.1.16 Bidder shall provide, install and connect a system equipment ground to owner's chimney grounding system. Equipment grounding system shall electrically connect panels and junction boxes which contain electrical devices, motors and elevator platform and structures. Raceway system shall not be considered as an equipment ground.

2.1.17 All enclosures containing electrical devices shall be provided with 240 V, single phase heaters with adjustable thermostat control.

2.1.18 Cab shall be equipped with a 240 V AC interior light and duplex outlet.

2.1.19 Cable accessories as required to install the cables in bidder's scope shall be provided by the bidders.

2.1.20 Complete erection, testing and commissioning including all erection materials, consumables and other tools and tackles required for erection along with commissioning spares.

2.1.21 All inserts, anchor bolts, sleeves, anchoring steel and any other items required to complete the job satisfactorily shall be in bidder's scope.

2.1.22 First fill of lubricant and consumables shall be in bidder's scope.

2.1.23 Satisfactory running and maintenance of elevator for a continuous period of 30 days including training of owner's operators.

2.1.24 Supply of One complete set of special maintenance tools and tackles shall be in bidder's scope.

2.1.25 Any other equipment or accessories not specified, but required for the satisfactory operation of chimney elevator shall be in bidder's scope.

2.1.26 Recommended spares including instrumentation for 3 years of normal operation of stack elevator. (List to be furnished by the bidder and for which order shall be placed separately by owner as per their requirements)

## 3. SPECIFIC REQUIREMENTS

3.1 The equipment supplied, erected and commissioned shall meet the technical requirements of respective Section –D and Data Sheet-A.

3.2 Bidder shall note that all QP and Field quality plans shall be subject to purchaser's approval.

3.3 All equipment offered shall have suitable provision of termination and connection of power and control cables inclusive of cable boxes, lugs and glands, etc.

3.4 All the equipment shall be suitable for the power supply fault level and other climatic conditions as indicated in project information.

3.5 The bidder shall guarantee the rating and performance parameters of the system/equipment offered in accordance with specification requirements.

3.6 It is the responsibility of bidder to arrange license for operation of chimney elevator from statutory body of that area before handing over.

3.7 Bidder shall furnish deviation (clause wise) in the deviation schedule. In absence of dully filled deviation list, it will be presumed that offer is exactly in line with the technical specification.

3.8 Bidder shall furnish duly filled data sheet –B along with the offer. In absence of same, offer shall be treated as incomplete.

3.9 Bidder shall offer the stack elevator considering prevailing statutory and regulatory requirements of project location.

3.10 Bidder shall indicate degree of protection of various electrical equipment in the offer.

3.11 Makes of all bought out items shall subject to purchaser's approval after award of contract.

3.12 All drawings/documents shall subject to purchaser's approval after award of contract.

*3.13* Please refer / comply customer- NTPC specification *(rack & pinion type elevator)*

# DATA SHEET

| | | | |
|---|---|---|---|
| 1 | Designation<br>Elevator | : | Rack and Pinion Type Stack |
| 2 | Type of loading | : | Passenger cum goods |
| 3 | Quantity<br>project requirement. | : | 4 nos. for 150 M high Chimney. |
| 4 | Carrying Capacity | : | 400 Kg (approximately) |
| 5 | Pay load | : | 400 Kg min. |
| 6 | Operating Speed | : | 40 m/min. |
| 7 | Dimension of lift and lift well/cut out | : | As per IS: 3534 |
| 8 | No. of landings | : | **For 150 M High Chimney=**<br>Four (04) nos. including ground (0.0m, 47m, 92m, & last landing at 137m). |
| 9 | Total vertical travel | : | 137 m. |
| 10 | Electrical power supply system | : | 415 V, 3 ph, 50 Hz |
| 11 | Other accessories | : | As required |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|

| | |
|---|---|
| **3.14.11** | **Rack and Pinion Elevator**<br><br>A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed |

| CLAUSE NO. | TECHNICAL REQUIREMENTS |
|---|---|
| | of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual |

TENDER NO PSER:SCT:NBN-C2067:20

## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 1. | PART-B | IV-D | 3.07.00 | 8 OF 69 | **Gypsum Storage Shed**<br>The Gypsum storage shed shall be RCC framed structure with structural steel work shed with permanently colour coated profiled steel sheet roof and side cladding, grade slab and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water | **Gypsum Storage Shed**<br>The Gypsum storage shed shall be RCC framed structure with RCC/ Brick infill wall **(upto Tripper floor)** and structural steel shed with permanently colour coated profiled steel sheet roof and side cladding **(above tripper floor)**. Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water. **At grade level Heavy duty paving as detailed elsewhere in the specification shall be provided inside the shed.** |

TENDER NO PSER:SCT:NBN-C2067:20

## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 2. | VI/B | IV-D | 3.14.01, Para 1 | 10 of 69 | Single-flue or multi-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level. | Single-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level. **The centre to centre distance between the proposed chimney(s) and the existing chimney(s) in any direction shall not be less than 150 metres.** |
| 3. | VI/B | IV-D | 3.14.08 | 14 of 69 | **Thermal insulation**<br><br>The insulation shall be semi rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. …….. pins and speed washer. | **Thermal insulation ( Applicable in case of Titanium / C-276 Flue Liner)**<br><br>The insulation shall be semi rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. …….. pins and speed washer. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 4. | VI/B | IV-D | 3.14.09, | 15 of 69 | (iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, **external surface of mini-shell above roof** etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. | (iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. |
| 5. | VI/A | II-A8 | 6.00.00, Annexure-B | 8 of 31 | a) The basic wind speed "$V_b$" at ten | a) The basic wind speed "$V_b$" at ten metres above the mean ground level : 47 metres/second |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 6. | VI/A | II-A10 | 7.02.00 | 10 OF 30 | For excavation 6 metres below FGL, sheet piling shall be provided. | Excavation may be carried out by using either sheet piling/ diaphragm wall/ secant piling/ contiguous piling or their combination. |
| 7. | VI/A | II-A7/A8/A3/A5/A11 | 7.02.03 (xv) | 14 OF 33/ 13 OF 31/ 14 OF 31/ 14 OF 40/ 15 OF 29 | High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical | **Either of Static routine load test** or High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | | | | | load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. | Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. |
| 8. | VI/A | II-A10 Project Information Barh STPP Stage-I | 7.00.00 | 10 to 13 of 30 | SOIL DATA AND FOUNDATION SYSTEM | **"SOIL DATA AND FOUNDATION SYSTEM"** given in **"Annexure-1"** to this amendment shall replace the contents of **Clause 7.00.00, Page 10 to 13 of 30,** Sub-section-II-A10, Part-A Sec-VI, of Tech. Specification. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 9. | VI/A | II-A6 Project Information Solapur | 7.00.00 | 9 to 21 of 31 | Foundation system & Geotechnical data | **"Foundation system & Geotechnical data"** given in **"Annexure-2"** to this amendment shall replace the contents of **Clause 7.00.00, Page 9 to 21 of 31,** Sub-section- II-A6, Part-A Sec-VI, of Tech. Specification. |
| 10. | VI/A | II-A4 Project Information Darlipali | Annexure-IV of clause 7.00.00 | - | - | **"Annexure-IV BORE LOGS"** at **"Annexure-3"** to this amendment added with clause 7.00.00, II-A4, Part-A Sec-VI, of Tech. Specification. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 11. | VI/A | II-A9 Project Information Meja TPP-I | Annexure-IV of clause 7.00.00 | | Annexure-IV Borelog | **"Bore Log "** given in **"Annexure-4"** to this amendment shall replace the contents of **Page 26 to 28 of 36 , Clause 7.00.00,** Sub-section-II-A9, Part-A Sec-VI, of Tech. Specification. |
| 12.. | VI/A | II-A1/A2//A4/ A5/ A6/A8/A11 | - | - | - | **Electrical Resistivity Test (ERT) Data at "Annexure-5".** |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 13. | VI/A | IIA2 Project Information Lara STPP Stage-I | 5.00.00 | 3 to 10 of 48 | "CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT" | **"CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT"** given in **"Annexure-6"** to this amendment shall replace the contents of **Clause 5.00.00, Sub-section- II-A2, Part-A Sec-VI, of Tech. Specification.** |
| 14. | VI/A | II-A10 Project Information Barh STPP Stage-I | 5.00.00 | 2 to 7 of 30 | "CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT" | **"CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT"** given in **"Annexure-7"** to this amendment shall replace the contents of **Clause 5.00.00, Sub-section- II-A10, Part-A Sec-VI, of Tech. Specification.** |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 15. | Section VI / Part A | Sub-Section III D | 1.06.00 | 2 of 4 | Uniform Finished Ground Level (FGL) in **FGD absorber area** shall be made available by the owner at a level specified in tender drawing. | Uniform Finished Ground Level (FGL) in **FGD areas** shall be made available by the owner at a level specified in tender drawing. |
| 16. | Section VI / Part A | Sub-section IIID | 2.00.00 | 2 of 4 | ……<br>……Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete (M 35) as per IRC standards, with minimum thickness of pavement (PQC) as 250mm. Width of all such roads shall be 7.5 M concrete pavement. | ……<br>……Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in M 35 grade) and DLC of 150 thick (in M 10 grade).<br>Double lane road (width 12m having 7.5m wide pavement & 2.25m wide shoulders on both sides) shall be provided. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 17. | Section VI / Part B | Sub-section IVD | 15.00.00 | 32 of 69 | ……<br>……<br>Sewage pump house shall be provided as per IS:4111. | ……<br>……. Sewage pumping stations shall be provided as per IS:4111. |
| 18. | Section VI / Part B | Sub-section IVD | 14.00.00 | 31 of 69 | ……<br>…..These values shall be based on rainfall intensity of **90mm/hr**<br>……<br>…… | ……..These values shall be based on rainfall intensity of **75mm/hr**<br>……<br>…… |

TENDER NO PSER:SCT:NBN-C2067:20

## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 19. | Section VI / Part A | Sub Section IIA10 Project information,<br><br>BARH STPP STAGE-1 (3X660MW) | 2.00.00 | 30 of 30 | | The topographical survey drawing no: 9562-999-POC-F-002 is attached with this amendment as **Annexure-8** |
| 20. | Section VI / Part A | Sub Section IIA8 Project information,<br><br>NABINAGA STPP STAGE-1 (3X660MW) | 10.00.00 | 31 of 31 | | The topographical survey drawing no: 0370-999-POC-F-002 is attached with this amendment as **Annexure-9** |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 21. | Section VI / Part A | Sub Section IIA2 Project information,<br><br>LARA STPP STAGE-1 (2X800MW) | - | 48 of 48 | | The topographical survey drawing no: 9548-999-POC-F-002 is attached with this amendment **as Annexure-10** |
| 22. | Section VI / Part B | Sub-Section-IV-D Civil Works | 4.02.00 | 18 to 19 of 69 | The scope for potable water supply includes all distribution …….. conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided.<br><br>**For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.** | The scope for potable water supply includes all distribution …….. conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 23. | Section VI / Part B | Sub-Section-IV-D Civil Works | 7.00.00, Para-2 | 24 of 69 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of **0.8mm** as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification. | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of **0.6mm** as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 24. | Section VI / Part B | Sub-Section-IV-D Civil Works | 3.03.00, Para-1 | 6 of 69 | The over ground portion of the transfer house shall be framed structure…… …Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams.**Contractor shall have option to use tubular steel sections for roof truss only**. Verticalbracings shall be provided only on four sides along the periphery. Grade slab with0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses. | The over ground portion of the transfer house shall be framed structure……Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 25. | Section VI / Part B | Sub-Section-IV-D Civil Works | 3.04.00, Para-1 | 7 of 69 | The crusher house shall be framed structure…… ……Adequate steel doors and windows for natural lighting and ventilation shall be provided. **Contractor shall have option to use tubular steel sections for roof truss only**. Vertical bracings shall be provided only on four sides along the periphery. | The crusher house shall be framed structure…… ……Adequate steel doors and windows for natural lighting and ventilation shall be provided. Vertical bracings shall be provided only on four sides along the periphery. |
| 26. | Section VI / Part B | Sub-Section-IV-D Civil Works | 3.09.00, Para-1 | 8 of 69 | All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. ……..For steel staircases , Stringers shall be of rolled steel channel (minimumISMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's. | All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. ……..For steel staircases, Stringers shall be of rolled steel channel (minimumISMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. **However sheeting shall be provided at the top**. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 27. | Section VI / Part B | Sub-Section-IV-D Civil Works | 3.01.00, Para-11 | 3 of 69 | Plinth protection along with drains shall be provided along the Hopper complex.<br>However, 5m wide paving shall also be provided around machinery hatches. | Plinth protection along with drains shall be provided along the Hopper complex. However, minimum 5m wide paving shall also be provided around machinery hatches **and Truck hopper**. |
| 28. | Section VI / Part B | Sub-Section-IV-D Civil Works | 24.00.00 , | 42 of 69 | **CONCRETE**<br>c) M35- For spring supported RCC deck | **CONCRETE**<br>c) M35- For spring supported RCC deck **and rail load bearing structure (if applicable).** |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| 29. | Section VI / Part B | Sub-Section-IV-D Civil Works | 39.03.00 , | 66 of 69 | Fly ash based Portland pozzolona cement conforming to IS: 1489 Part - I shall preferably be used. However, the contractor may use other types of cements conforming to IS: 269, IS: 8112, IS: 12269, & IS: 455. | **Cement**<br>Fly ash based portland pozzolana cement conforming to IS:1489 (Part-1) shall be used for all areas other than for the critical structures identified below. Other properties shall be as per IS code.<br>Ordinary Portland Cement (OPC) shall necessarily be used for the following structures.<br>a) Spring supported decks of limestone crusher<br>b) RCC for Chimney shell.<br>The grade of cement shall be Grade 43 for OPC conforming to IS:8112.<br>In place of fly ash based portland pozzolana cement, OPC mixed with Fly Ash can be used. Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS:3812(Part I & Part II). Percentage of fly ash to be mixed in concrete shall be based |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. No. | Section / Part | SUB SECTION | Clause No. | Page No. | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | | | | | | on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement. |
| 30. | Section VI / Part B | Sub-Section-IV-D Civil Works | 39.05.00 , | 66 of 69 | - | **Aggregates**<br>a) **Coarse Aggregate**<br>Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383.<br>b) **Fine Aggregate**<br>Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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| | | | | | | pellets. Fine aggregate in concrete shall conform to IS : 383. For plaster, it shall conform to IS : 1542 and for masonry work to IS : 2116.<br><br>c) Petrographic examination of aggregate shall be carried out by the contractor at National Council for Cement and Building Materials (NCB), Ballabgarh, or any other approved laboratory to ascertain the structure and rock type including presence of strained quartz and other reactive minerals. In case, the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining the rock type, special emphasis should be given on identification of known reactive rocks like |

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| | | | | | | chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed.<br><br>The laboratory shall determine potential reactivity of the aggregate, which may lead to reaction of silica in aggregate with the alkalis of cement and / or potential of some aggregates like limestone to cause residual expansion due to repeated temperature cycle. If the same is established, the contractor shall further carry out alkali aggregates reactivity test as per IS 2386 (Pt.VII) and / or repeated temperature cycle test to establish the suitability of the aggregates for the concrete work. The test results, with the final recommendations of the laboratory, as to a suitability of the aggregate, for use in the concrete work for various structures and suggested measures, in case of results |

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| | | | | | | are not satisfactory, shall be submitted to the Engineer for his review, in a report form.<br><br>In case in the report, it is established, that the aggregates contain reactive silica, which would react with alkalis of the cement, the contractor shall change the source of supply of the aggregate or use low alkali cement as per recommendation or take measures as recommended in the report as instructed by Engineer.<br><br>In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10° Celsius to 65° Celsius and for 60 temperature cycles) the material shall not be used for concreting of Lime stone crusher decks, Mills, Fans and other equipment foundations which are likely to be subjected to repeated |

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| | | | | | | temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test. |
| 31. | Section VI / Part B | Sub-Section-IV-D Civil Works | 8.00.00, Para-3 | 26 of 69 | Bricks to be used in brickwork shall be of minimum Class designation 50. | Only fly ash bricks shall be used in all construction. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm$^2$. Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS 13757 and IS 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%. |

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| 32. | SECTION – VI, PART-B | SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM | 9.05.00 | 19 of 27 | Bidder shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and datasheets etc. & this shall be finalized subject to employer's approval during detail engineering.<br><br>Configuration B :<br>UPS system shall consist of 1 x 100% charger and inverter, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories. | Bidder shall clearly bring out in the proposal the configuration diagram, single line diagram and datasheets etc. & this shall be finalized subject to employer's approval during detail engineering.<br><br>Configuration B :<br>UPS system shall consist of 1 x 100% charger and inverter with input isolation transformer, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories. |
| | SECTION – VI, PART-E | Tender drawing C&I | | 18 of 53 (of PDF) | Scheme of UPS system Configuration-B Drg. no. 0000-999-POI-A-019C | UPS Configuration-B drawing 0000-999-POI-A-019C updated. |

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| 33. | SECTION – VI, PART-A | SUB-SECTION-IIIC C&I | New clause 1.00.00 e) | 1 of 8 | | 1.00.00 e) Scope defined in PART-A read in conjunction with PART-B has to be provided for each station (i.e. 11 sets for 11 stations) under LOT-1A package. The scope detailed hereunder in the following clauses is for one set. |
| 34. | SECTION – VI, PART-E | Tender drawing C&I | | 13 of 53 (of PDF) | Standard configuration drawing for PLC based offsite control system. Tender drawing no. 0000-151-POI-A-013 (Rev no. A). | Standard configuration drawing for PLC based offsite control system. Tender drawing no. 0000-151-POI-A-013 (Rev no. B). |
| 35. | SECTION – VI, PART-A | SUB-SECTION-IIIC C&I | New clause 2.07.00 | 4 of 8 | - | 2.07.00 Contractor shall provide one no. of Hand held HART calibrator per generating unit. |

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| 36. | SECTION – VI, PART-A | SUB-SECTION-IIIC C&I | New clause 6.08.00 | 7 of 8 | - | 6.08.00 Binary and modulating controls of complete Flue gas desulphurization system, associated material handling systems etc. and other systems being provided under the contract shall be implemented in PLC. The PLC based Control System shall have separate process blocks for unitised system and one process block for common system including material handling system. For example in KUDGI-I (3x800MW), the PLC based control system shall have following process blocks:<br>(i) Unit-1 FGD and associated system<br>(ii) Unit-2 FGD and associated system<br>(iii) Unit-3 FGD and associated system<br>(iv) Common system including material handling systems. |
| 37. | SECTION – VI, PART-B | SUB-SECTION-III-C2, MEASURING INSTRUMENTS | 8.00.00 | 16 OF 34 | Coriolis Flow Transmitter:<br>Viscosity range of Fluid 0-500cst for HFO. | Coriolis Flow Transmitter:<br>Viscosity range of Fluid 0-500cst for HFO. |

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| 38. | SECTION – VI, PART-A | SUB-SECTION-IIIC C&I | 6.01.00 | 7 of 8 | 6.01.00 …….. on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). The PLC configuration drawing…… | 6.01.00 …….. on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). However, bidder to consider minimum quantity of OWS and OWS cum EWS as follows:<br>a) OWS (placed in FGD control room)-(N+1) where N is the total number of generating units per project under this package.<br>b) OWS cum EWS (placed in FGD control room)-ONE (1)<br>c) OWS (placed in central control room of each generating unit)-TWO (2).<br>The PLC configuration drawing…… |

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| 39. | SECTION – VI, PART-A | SUB-SECTION-IIIC C&I | New clause 6.09.00 | 7 of 8 | ------ | 6.09.00 The Bidder shall provide maintenance services of complete control System under a comprehensive Annual Maintenance Contract (AMC) for period of three year after Warranty period. |
| | SECTION – VI, PART-B | SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM | 16.01.00 | 26 of 27 | 16.01.00 The Bidder shall provide maintenance services of complete control System under a comprehensive Annual Maintenance Contract (AMC) for period of one year after Warranty period and thereafter AMC for only hardware support for next two years. | 16.01.00 The Bidder shall provide maintenance services of complete control System under a comprehensive Annual Maintenance Contract (AMC) for period of three year after Warranty period. |
| 40. | SECTION – VI, PART-E | Tender drawing C&I | | 19 and 20 of 53 (of PDF) | Instrumentation/control/power supply cabling diagram Drg No. 0000-101/102-POI-A-021 Sheet 1 of 3 and sheet 2 of 3 | Instrumentation/control/power supply cabling diagram Drg No. 0000-101/102-POI-A-021 Sheet 1 of 3 and sheet 2 of 3 updated. |

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| 41. | SECTION – VI, PART-A | SUB-SECTION-IIIC C&I | 7 of 8 | New clause 6.10.00 | - | 6.10.00 Contractor shall provide control desk placed in FGD control room, meeting specification requirements stipulated in clause 10.04.00, PART-B, Sub Section III-C5 of technical specification.<br>Contractor shall also provide a control desk for each generating unit, of length 2 meter aesthetically matching with the existing control desk of main plant Central Control Room (CCR) for placing FGD OWS in main plant CCR. |
| 42. | SECTION – VI, PART-E | Tender drawing | | 5 of 53 (of PDF)<br><br>6 of 53 (of PDF) | Tender drawing no. 0011-109-POM-A-001(a): Scheme of FGD Absorber system (Single unit)<br><br>Tender drawing no. 0011-109-POM-A-001:<br>Scheme of FGD Absorber system (For two units) | NOTE 13 and 17 deleted<br><br>NOTE 13 and 17 deleted |

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| 43. | SECTION – VI, PART-A | SUB-SECTION-IV Terminal points and exclusions | 1.14.00 | 3 of 3 | 1.14.00 Control & Instrumentation<br><br>a) Employer's marshalling cabinets for hardwired signal exchange with Employer system.<br>b) Instrument air at one point (if required).<br>c) One (1) no. 240V, single phase, 50 Hz feeder per unit for meeting the unregulated AC power supply requirement for illumination, heating, ventilation, and utility outlets, etc. at bidder's Power supply distribution panel.<br>d) Two (2) 415 V, 3 – phase 3 wire, 50 Hz feeder for each set of the bidder's 24 V DC system. | 1.14.00 Control & Instrumentation<br><br>a) Employer's marshalling cabinets for hardwired signal exchange with Employer system.<br>b) Employer's station wide LAN switch.<br>c) One (1) no. 240V, single phase, 50 Hz feeder per unit for meeting the unregulated AC power supply requirement for illumination, heating, ventilation, and utility outlets, etc. at bidder's Employer's Power supply distribution panel. |
| 44. | SECTION – VI, PART-B | SUB-SECTION-III-C2, MEASURING INSTRUMENTS | 11.07.00 Note 1 | 30 OF 34 | NOTES:-<br>01. Hot extractive sampling type/ Dilution extractive type systems shall be provided with dual sample probes along with all required accessories such | NOTES:-<br>01. Hot extractive sampling type/ Dilution extractive type systems shall be provided with dual sample probes along with all required accessories such as |

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| | | | | | as redundant heavy duty pumps with continuous rated motors, moisture detection facility, pre-fabricated heated (for sampling type only) sample lines from probes to analyser panel, solenoid valves, filters, coolers along with level switch in gas coolers for auto draining purpose and flow meter etc as applicable. | redundant heavy duty pumps with continuous rated motors, moisture detection facility, pre-fabricated heated (for sampling type only) sample lines from probes to analyser panel, solenoid valves, filters, coolers along with level switch in gas coolers for auto draining purpose and flow meter etc as applicable. Alternatively, permeation based dryer (located near the tapping point) may also be provided in place of sample cooler. |
| 45. | SECTION – VI, PART-A | SUB-SECTION-VII, Mandatory Spares | 1.25.00 | 45 of 61 | 1.25.00 CONTROL AND INSTRUMENTATION | 1.25.00 CONTROL AND INSTRUMENTATION (EXCLUDING AIR CONDITIONING AND VENTILATION SYSTEM, COMPRESSED AIR SYSTEM, FIRE DETECTION AND PROTECTION SYSTEM. For mandatory spare of these systems, refer mandatory spare clauses specified under respective systems) |

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| 46. | SECTION – VI, PART-A | SUB-SECTION-IIIC C&I | 6.07.00 | 7 of 8 | ……..UPS of suitable capacity for the intended application meeting the requirements of Technical Specifications as per Cl. No. 9.05.00, Part B, III-C5.<br>Contractor to note that UPS of configuration C is acceptable only upto 5 KVA. In case the consolidated load requirements…… | ……..UPS of suitable capacity for the intended application meeting the requirements of Technical Specifications as per Cl. No. 9.05.00, Part B, III-C5. Contractor shall provide Mini UPS for 01 (one) no. of OWS cum EWS.<br>Contractor to note that UPS of configuration C is acceptable only upto 5 KVA. In case the consolidated load requirements…… |
| 47. | SECTION – VI, PART-A | SUB-SECTION-IIIC C&I | New clause 6.11.00 | 7 of 8 | - | Output redundancy is applicable for 10% of drives distributed in various functional groups (Exact application shall be finalized during detailed engineering). |
| 48. | SECTION – VI, PART-B | SUB-SECTION-III-C2 MEASURING INSTRUMENTS | 2.01.00 (16) | 3 of 34 | 16. Adjustment/calibration/maintenance: From hand held HART calibrator/ centralized PC based system (as applicable). | 16. Adjustment/calibration/maintenance: From hand held HART calibrator/ centralized PC based system (as applicable). |
| 49. | Part B (1)– Section VI | Sub Section-I-M1 | 6.02.03 | 21 of 51 | Each silo shall be provided with sufficient no. of level transmitters. | Each Silo shall be provided with minimum 02 no. of Level transmitters per silo. |

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| 50. | SECTION – VI, PART-A | SUB SECTION VI | S.NO xii, CL.NO. 5.00.00 | 21 of 24 | DM COOLING (NORMALLY WORKING) WATER PUMP ONE (1) TO SUPPLY COOLING WATER ON THE PRIMARY (DM) SIDE OF THE PLATE TYPE HEAT EXCHANGER IN THE CLOSED LOOP EQUIPMENT COOLING WATER SYSTEM. | FGD DM (Primary) Cooling water pump (all working pumps) to supply cooling water on the primary (DM) side of the plate type heat exchanger in the closed loop equipment cooling water system. |
| 51. | SECTION – VI, PART-A | Sub section VI | S.No xiii CL.NO. 5.00.00, | 21 of 24 | AUXILIARY COOLING (NORMALLY WORKING) WATER PUMP ONE (1) TO SUPPLY COOLING WATER ON THE SECONDARY SIDE OF THE PLATE TYPE HEAT EXCHANGER IN THE CLOSED LOOP EQUIPMENT COOLING (UNIT AUXILIARY) WATER SYSTEM. | FGD Auxiliary (Secondary) Cooling water pumps (all working pumps) to supply cooling water on the secondary side of the plate type heat exchanger for FGD equipment cooling water system. |

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| 52. | SECTION – VI, PART-A | Sub section IV | 1.06.00 | 2 of 3 | FOR GYPSUM WASHING, CONTRACTOR SHALL TAKE A TAP OFF SUITABLY FROM THE EXISTING HVAC HEADER (HVAC MAKE UP PUMP DISCHARGE) AVAILABLE ALONG C-ROW AT CD BAY RACK FOR MEETING THE WATER REQUIREMENT OF GYPSUM WASHING. THE PRESSURE AVAILABLE AT TP WILL BE 4 KSC (GAUGE) WRT FGL (APPROX.). | For Gypsum washing, contractor shall take a tap off suitably from the existing HVAC header (HVAC make up pump discharge) available along C-row at CD bay rack for meeting the water requirement of gypsum washing. The water quantity and pressure available at TP will be 20m3/hr & 4 Ksc (gauge) wrt FGL (approx.) respectively. |
| 53. | VI Part-A | III-A5 | 1.02.01 | 1 of 6 | Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed Layout submitted with the bid. *In the absence of this, the bid shall be deemed incomplete and may be liable for rejection*. | Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. **All required modification and demolition work of existing facilities shall be in the bidder's scope. However if any relocation of existing facility is required, the same shall be done by the employer.** Bidder shall bring out all necessary modification and relocation of existing facilities, if |

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| | | | | | | required, along with proposed Layout submitted with the bid. *In the absence of this, the bid shall be deemed incomplete and may be liable for rejection*. |
| 54. | Section-VI, Part A | III-A5 | 2.01.01 | 2 of 6 | **Lime stone received through Road** shall be unloaded by Two (2) numbers Truck Tipplers each of minimum 20T capacity to discharge Limestone on to Box Feeders/ Surface Feeders/ Truck Unloading Hopper, complete with all mechanical, electrical and C&I, civil & structural works for unloading Limestone by truck tipplers.<br><br>TWO (2) NUMBERS BOX FEEDERS/ BULK-MATERIAL RECEIVING UNIT/ UNDERGROUND TRUCK UNLOADING HOPPER / SURFACE FEEDER, FOR UNLOADING OF LIMESTONE FROM TRUCKS/ SELF-TIPPLING TRUCKS/ LOADER SHOVELS, COMPLETE WITH | **Lime stone received through Road** shall be unloaded by Two (2) numbers Truck Tipplers each of minimum **40T** capacity **(Gross weight 60 T minimum)** to discharge Limestone on to Box Feeders/ Surface Feeders/ Truck Unloading Hopper, complete with all mechanical, electrical and C&I, civil & structural works for unloading Limestone by truck tipplers.<br><br>Two (2) numbers Box Feeders/ Bulk-material Receiving Unit/ ~~**Underground Truck Unloading Hopper /**~~ Surface feeder, for unloading of limestone from trucks/ self-tippling trucks/ loader shovels, complete with drives, accessories all mechanical, electrical and C&I, Civil & structural works, including its |

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| | | | | | DRIVES, ACCESSORIES ALL MECHANICAL, ELECTRICAL AND C&I, CIVIL & STRUCTURAL WORKS, INCLUDING ITS SUPPORTING FOUNDATIONS ETC. THIS UNIT SHALL FEED LIMESTONE ONTO THE CONVEYOR BEFORE LIMESTONE CRUSHER HOUSE. | supporting foundations etc. This unit shall feed limestone onto the conveyor before Limestone crusher house. |
| 55. | -- | -- | -- | -- | Vibrating Feeder | **Vibrating Screening Feeder** |
| | | | | | Vibrating (Grizzly/Screening) Feeder | |
| | | | | | Vibrating Grizzly/Screening Feeder | |
| | | | | | Vibrating grizzly Feeders | |
| | | | | | Vibrating Screen Feeder | |

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| 56. | Section-VI, Part A | III-A5 | 2.01.07 | 3 of 6 | Crushed limestone Reclaim Hopper (RH) /Silo…… For Limestone storage shed and for all buildings, other equipment such as DS system, ventilation system, drinking water system, drainage system etc. as specified elsewhere in the specification. | Crushed limestone Reclaim Hopper (RH) /Silo…… For Limestone storage shed and for all buildings, other equipment such as **Dry type Dust Extraction** system, ventilation system, drinking water system, drainage system etc. as specified elsewhere in the specification. |
| | Section-VI, Part B | I-M6 | 4.11.3 (v) | 15 of 73 | The Contractor ……... For specification of dust suppression equipment for paddle feeder, refer relevant Sub-section of this Specification. | The Contractor ……... For specification of **Dry type Dust Extraction System** for paddle feeder, refer relevant Sub-section of this Specification. |
| | Section-VI, Part B | I-M6 | 4.13.7 | 19 of 73 | Hoists with monorail of adequate capacity shall be provided in the service water/dust suppression/ potable water pump houses. | Hoists with monorail of adequate capacity shall be provided in the service water/~~**dust suppression/**~~ potable water pump houses. |

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| 57. | Section-VI, Part A | III-A5 | 2.01.28 | 5 of 6 | Minimum one (1) no. Weighing Bridge for Road trucks / Tipplers shall be provided each in Limestone unloading area and in Gypsum Loading area. | Minimum one (1) no. Weighing Bridge **of capacity 100 MT** for Road trucks / Tipplers shall be provided each in Limestone unloading area and in Gypsum Loading area. |
| 58. | Section-VI, Part A | III-A5 | 2.01.19 | 4 of 6 | One (1) number of passenger cum goods elevator with drives, all electrical, mechanical, civil, structural & associated foundation works, accessories and electrical to serve various floors of lime stone crusher house. | One (1) number **conventional enclosure type** passenger cum goods elevator **having capacity of 16 persons (1088 kg) complying to IS:14665 (latest edition)** with drives, all electrical, mechanical, civil, structural & associated foundation works, accessories and electrical to serve various floors of lime stone crusher house. **Staircase access for machine room shall also be provided by the bidder.** |

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| 59. | Section-VI, Part A | III-A5 | 3.03.00 | 6 of 6 | Minimum four (2) Nos. sump pumps in gypsum storage shed complete with motors, local control panel, level switches, individual discharge piping with fittings and valves **to nearest plant drain including pipes etc. up to disposal point.** | Minimum four (**4**) Nos. sump pumps in gypsum storage shed complete with motors, local control panel, level switches, individual discharge piping with fittings and valves **upto Bottom Ash Slurry Sump.** |
| 60. | Section-VI, Part A | III-A5 | 2.01.11 | 3 of 6 | One number of covered storage shed for crushed limestone. The storage shed shall be sufficient to store limestone equivalent to consumption of minimum 7 days at Design point (Generation of all units to be considered). A reclaim hopper shall be provided below the limestone storage shed for the entire length of the stockpile. Alternatively, suitable number of Limestone Storage Silos to store limestone equivalent to consumption of minimum 7 days. Suitable number of Belt feeders below silos shall be | One number of covered storage shed for crushed limestone. The storage shed shall be sufficient to store limestone equivalent to consumption of minimum 7 days at Design point (Generation of all units to be considered) **or 5000 MT (wherever Railway Rake unloading is envisaged) whichever is higher**. A reclaim hopper shall be provided below the limestone storage shed for the entire length of the stockpile. Alternatively, suitable number of Limestone Storage Silos to store limestone equivalent to consumption of minimum **7 days at Design point or 5000 MT** |

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| | | | | | provided taking feed from silo and discharging onto onward conveyors/ Bucket elevators. | **(wherever Railway Rake unloading is envisaged) whichever is higher**. Suitable number of Belt feeders below silos shall be provided taking feed from silo and discharging onto onward conveyors/ Bucket elevators. |
| 61. | Section-VI, Part A | VI | 5.00.00 | 20 of 24 | **AUXILIARY POWER CONSUMPTION(PA) FOR EACH PROJECT**<br>The unit auxiliary power consumption<br>……..<br>xxix. Power consumption of Mechanical vapour Compressor divided by the number of units in the projects, in case ZLD system is provided<br><br>The equipment's listed above for calculating…… power consumption. | **AUXILIARY POWER CONSUMPTION(PA) FOR EACH PROJECT**<br>The unit auxiliary power consumption<br>……..<br>xxix. Power consumption of Mechanical vapour Compressor divided by the number of units in the projects, in case ZLD system is provided.<br><br>**xxx. a) Power consumption of lime stone unloading, conveying, crushing , storage & reclaiming system (Single stream)** except Lighting, Hoists, sampling unit, Sump Pumps, |

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| | | | | | Note:<br><br>1. The bidder…….....approval.<br>2. The equipments…….. consumption. | Elevators, DE, Ventilation, SW System, Potable water system – **for road unloading system (if only road unloading system is provided)**<br><br>**or**<br>**b) Power consumption of lime stone conveying (starting from feed point from existing Coal Handling Plant), crushing, storage & reclaiming system (Single stream)** except Lighting, Hoists, sampling unit, Sump Pumps, Elevators, DE, Ventilation, SW System, Potable water system **– for Indian Railway's unloading system.**<br><br>**xxxi. Power consumption of Gypsum conveying system (Single Stream)** except Lighting, Hoists, sampling unit, Sump Pumps, Elevators, DE, Ventilation, SW System, Potable water system.<br><br>The equipment's listed above for calculating……po |

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| | | | | | | wer consumption.<br><br>Note:<br><br>1. The bidder…….....approval. The equipments…….. consumption. |
| 62. | Section-VI, Part A | V | 10.00.00 | 21 of 26 | **LIMESTONE HANDLING PLANT** | **LIMESTONE AND GYPSUM HANDLING PLANTS** |
| 63. | Section-VI, Part A | | 10.01.00 | 21 of 26 | Rated capacity of Limestone handling system from existing CHP shall be 1200 TPH upto crushed limestone storage system. Belt speed of conveyors shall not be more than 3.4 m/s. | **a.** Rated capacity of Limestone handling system from existing CHP shall be 1200 **MTPH** upto crushed limestone storage system. **Rated capacity of all other Limestone Handling Conveyors shall be 150 MTPH (min).**<br>**b. Rated capacity of Limestone handling system for truck unloading and reclaim conveyors from storage shed/silo to limestone mill bunkers shall be 150 MTPH (min).** |

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| | | | | | | **c. The rated capacity of all Gypsum handling conveyors shall be 150MTPH.**<br><br>Belt speed for 1200 MTPH conveyors shall not be more than 3.4 m/s, and belt speed for 150 MTPH conveyors shall not be more than 2.0 m/s |
| 64. | Section-VI, Part A | V | 10.02.00 | 21 of 26 | All conveyors shall be designed for 110% of rated capacity.<br><br>Rated capacity (corresponding to **CHP** capacity) shall be guaranteed capacity for 100% duty equipment. For 50% duty equipment design capacity shall be guaranteed capacity.<br><br>For purpose of guaranteed power consumption rated capacity shall be considered in either case. | All conveyors shall be designed for 110% of rated capacity.<br><br>Rated capacity (corresponding to **LHP&GHP** capacity) shall be guaranteed capacity for 100% duty equipment. For 50% duty equipment design capacity shall be guaranteed capacity.<br><br>1. For purpose of guaranteed power consumption rated capacity shall be considered in either case. |

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| 65. | Section-VI, Part A | V | 10.03.00 | 21 of 26 | 2x100 %( one working + one standby) conveying stream shall be provided in the **CHP.** | 2x100 %( one working + one standby) conveying stream shall be provided in the **LHP&GHP**. |
| 66. | Section-VI, Part A | V | 10.06.00 e) | 22 of 26 | e) The following aspects shall be taken care of **coal / limestone**:<br>i) The limestone delivered to power station shall be of size 250mm and below. However, occasionally 1-2% **coal** of 400 mm lump size may also be encountered.<br>ii) Due to open cast method of mining involved, the **coal** may contain shale and sand stone as high as 20%. Also occasionally, metal pieces like broken shovel teeth, brake shoe, wires etc. may also come along with **coal/ Limestone.**<br>iv) The **coal / limestone** as received' shall contain varying | e) The following aspects shall be taken care of **limestone**:<br>i) The limestone delivered to power station shall be of size 250mm and below. However, occasionally 1-2% **limestone** of 400 mm lump size may also be encountered.<br>ii) Due to open cast method of mining involved, the **limestone** may contain shale and sand stone as high as 20%. Also occasionally, metal pieces like broken shovel teeth, brake shoe, wires etc. may also come along with l**imestone.**<br>iv) The **limestone** as received' shall contain varying percentage of fines. This may form adhesive lumps particularly during monsoon when surface moisture is at its |

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| | | | | | percentage of fines. This may form adhesive lumps particularly during monsoon when surface moisture is at its maximum value. The sizing and selection of all equipment shall take care of above. | maximum value. The sizing and selection of all equipment shall take care of above. |
| 67. | Section-VI, Part A | V | 10.08.00 | 22 of 26 | **Drive equipment Rating**<br><br>Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors<br><br>a) For conveyors of belt conveyor systems<br><br>***120%** of actual power at drive motor output shaft at specified design capacity<br><br>..... | **Drive equipment Rating**<br><br>Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors<br><br>a) For conveyors of belt conveyor systems<br><br>***110%** of actual power at drive motor output shaft at specified design capacity<br><br>..... |

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| 68. | Section-VI, Part A | V | 10.11.00 | 23,24 of 26 | Belting and Pulleys for 1200 TPH<br>.....<br>……..<br>Belting and Pulleys for 150TPH rated conveying capacity (LHP &GHP)<br>(a)……<br>(b)…….<br>(c)…..<br>**(d) Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to three (3) nos. These shall comprise of two (2) nos. drive pulleys & one (1) no. for all balance pulleys excluding tripper & SS pulleys.** | Belting and Pulleys for 1200 TPH<br>.....<br>……..<br>Belting and Pulleys for 150TPH rated conveying capacity (LHP &GHP)<br>(a)……<br>(b)…….<br>(c)….. |

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| 69. | Section-VI, Part A | V | 10.13.00 | 24 of 26 | 2x100 %( one working + one standby) conveying stream shall be provided in the limestone and gypsum handling system. | Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to five (5) nos. These shall comprise of two (2) nos. drive pulleys & three (3) no. for all balance pulleys excluding tripper & SS pulleys. |
| 70. | Section-VI, Part A | V | 10.14.00 | 24 of 26 | The covered storage shed/silo for limestone shall be sufficient to store limestone equivalent to consumption of minimum 7 days. The covered storage……7 days.<br><br>Further approval…….. of the pulley diameters.<br><br>**Maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to five (5). These shall comprise of two (2) nos. drive pulleys and three (3) nos. for all balance pulleys. Pulleys for Belt** | The covered storage shed/silo for limestone shall be sufficient to store limestone equivalent to consumption of minimum 7 days **at Design point (Generation of all units to be considered) or 5000 MT (wherever Railway Rake unloading is envisaged) whichever is higher**. The covered storage……7 days.<br><br>**At least One third ( 1/3 rd) of total stipulated crushed limestone storage shall be considered in the hopper, if applicable, and hopper length shall be equal to stockpile** |

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| | | | | | **Feeder, fixed &travelling tripper, SS pulleys & S/R pulleys are not included in the above categories.** | **length placed along the tripper centerline.**<br><br>Further approval……. of the pulley diameters. |
| 71. | Section-VI, Part A | V | 10.15.00 | 25 of 26 | **Dust extraction system**<br><br>Type: Venturi scrubber type<br><br>Location: **Belt feeder after crusher & Vibrating Screening Feeder at crusher house.** | **Dust extraction system**<br><br>Type: Venturi scrubber type<br><br>Location: **Truck un-loading points, Junction Towers (limestone/ gypsum discharge & receipt points), limestone crusher house (including belt feeder & vibrating screening feeder) and lime stone/gypsum storage Shed/Silo.** |

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| 72. | Section-VI, Part A | V | 10.18.00 | 25 of 26 | **Chutes:**<br>Minimum clear cross section of chute: 1000 mm X 800 mm (inside both ways) | **Chutes:**<br>Minimum clear cross section of chute: 1000 mm X 800 mm (inside both ways) for 1200 mm Belt Width.<br>Minimum clear cross section of chute: 900 mm X 600 mm (inside both ways) for 800 mm Belt Width. |
| 73. | Section-VI, Part A | V | 11.00.00<br>11.01.00<br>11.02.00<br>11.03.00<br>11.04.00<br>11.05.00 | 25 of 26 &<br>26 of 26 | **LIMESTONE HANDLING PLANT AND GYPSUM HANDLING PLANT**<br>…….. | **Deleted** |
| 74. | Section-VI, Part B | I-M6 | 1.0.0 | 1 of 73 | **INTRODUCTION**<br>This section of the specification provides the detailed technical requirements for the **Limestone Handling System**. | **INTRODUCTION**<br>This section of the specification provides the detailed technical requirements for the **Limestone & Gypsum Handling System**. |

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| 75. | Section-VI, Part B | I-M6 | Footer | All Pages | **SUB-SECTION-I-M6**<br><br>**LIMESTONE HANDLING PLANT(LHP)** | **SUB-SECTION-I-M6**<br><br>**LIMESTONE AND GYPSUM HANDLING PLANT(LHP & GHP)** |
| 76. | Section-VI, Part B | I-M6 | 3.3.0 | 3 of 73 | In limestone crusher house, limestone from each incoming Conveyor shall pass through two (2) numbers of (dedicated) Vibrating grizzly/ screening Feeders and two (2) numbers of (dedicated) crushers respectively which shall crush limestone to (-) 20mm size or to suit limestone pulverizer and system……..<br>……<br>in limestone crusher house. | In limestone crusher house, limestone from each incoming Conveyor shall pass through **one (1) or** two (2) numbers, as applicable, of (dedicated) Vibrating ~~grizzly/~~ screening Feeders and **one (1) or** two (2) numbers, as applicable, of (dedicated) crushers respectively which shall crush limestone to (-) 20mm size or to suit limestone pulverizer and system……..<br>……<br>in limestone crusher house. |
| 77. | Section-VI, Part B | I-M6 | 4.0.0 | 3 of 73 | **MAJOR EQUIPMENT OF LIMESTONE HANDLING SYSTEM AND GYPSUM HANDLING SYSTEM**<br><br>Specifications for **Coal Handling system** equipments shall be generally followed for Lime Handling System & Gypsum handling System | **MAJOR EQUIPMENT OF LIMESTONE HANDLING SYSTEM AND GYPSUM HANDLING SYSTEM** |

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| | | | | | unless specified otherwise. | |
| 78. | Section-VI, Part B | I-M6 | 4.1.1 | 4 of 73 | **Belting:**<br>The belting shall be of either synthetic fabric such as Nylon-Nylon etc. with rubber covers of adequate flexibility to give a troughing angle of 35 deg.<br>For all the conveyors the number of plies, cover thickness, factor of safety etc. shall be as per the recommendation of belt manufacturer, but not inferior to the figures as tabulated in data sheet. *Longitudinal joints in the plies of synthetic fabric belts is not permitted.* | **Belting:**<br>The belting shall be of either synthetic fabric such as Nylon-Nylon etc. with rubber covers of adequate flexibility to give a troughing angle of 35 deg.<br>**Belt Width : 800 mm (Min) for 150 MTPH**<br>**1200 mm (Min) for 1200 MTPH**<br>For all the conveyors the number of plies, cover thickness, factor of safety etc. shall be as per the recommendation of belt manufacturer, but not inferior to the figures as tabulated in data |

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| | | | | | | sheet. Longitudinal joints in the plies of synthetic fabric belts is not permitted. |
| 79. | Section-VI, Part B | I-M6 | 4.5.3 | 9 of 73 | ..... Alternatively, Air cooled type scoop coupling is also acceptable for all conveyors with HT motors for (AHP, LHP, GHP) and crusher scoop couplings. Suitable interlock..... | ..... Alternatively, Air cooled type scoop coupling is also acceptable for all conveyors with HT motors for (~~AHP,~~ LHP, GHP) and crusher scoop couplings. Suitable interlock..... |
| 80. | Section-VI, Part B | I-M6 | 4.6.4 | 10 of 73 | **New Clause** | All vertical steel members (in Junction Towers/Transfer Points and Crusher House) supporting the conveyors, equipment shall be mounted on 150MM concrete pedestals above floor level to avoid their direct contact with water. |
| 81. | Section-VI, Part C | GTR | 30.00.00 | 42 of 83 | **NOISE LEVEL**<br>The equivalent 'A' weighed sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any | **NOISE LEVEL**<br>The equivalent 'A' weighed sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and |

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| | | | | | equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA. However for Balls Mills the noise levels as per following shall also be acceptable:<br>a) Ball Mill <90 dBA | installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA. However for Balls Mills **and limestone crusher** the noise levels as per following shall also be acceptable:<br>a) Ball Mill <90 dBA<br>**b) Limestone Crusher <90 dBA** |
| 82. | SECTION – VI, PART-A | SUB-SECTION-III-B ELECTRICAL SYSTEM/ EQUIPMENT | 1.15.00 | 5 of 6 | ------- | Power supply arrangement for FGD system has been indicated in the Single line diagrams tender SLD 0011-109-POE-J-001 A/B/C attached at Part-E section VI of the technical specifications.<br>Id booster fans (largest 11kV motor, Max. 2 Nos. per unit) shall be fed from spare panels available in existing station switchgear in each project. The spare feeders which have been identified for this purpose in each of the projects are indicated in the table attached at **Annexure-E1** to this document. Any augmentation required in the |

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| | | | | | | switchgear panels for this purpose (conversion from Transformer feeder to Motor feeder, change in CT rating Etc.) required for making the panel suitable for above use shall also be in the scope of bidder.<br>Other FGD loads (except indicated above) shall be fed by creating new 11kV FGD tie switchgear and subsequent additional voltage levels as required. The feeders currently being used for feeding ESP standby transformer (ESP Trf #G/H) shall be used for extending power supply from station board to 11kV FGD Tie switchgear. If the rating of the VCB in this panel in station switchgear is less than 1600A, VCB shall be replaced by new 1600A VCB for this purpose. Other necessary augmentation in panel for conversion from transformer feeder to TIE feeder, change in CT rating etc. required for making the panel suitable for the above use shall also be in scope of bidder. Entire cabling |

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| | | | | | | and re-cabling required as per the above scheme shall be in bidder's scope. Bidder will be required to feed the ESP standby transforms from this new FGD Tie switchgear. In case of Nabinagar 4x250MW project feeding shall be as indicated in Single line diagrams tender SLD 0011-109-POE-J-001 C. In this case ID booster fans along with all other FGD loads shall be fed from 6.6kV FGD Tie switchgear (one set for two units each). The feeders currently being used for feeding ESP standby transformer (ESP Trf #C) shall be used for extending power supply from station board to 6.6kV FGD Tie switchgear. |

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| 83. | SECTION – VI, PART-E | III A-1 | 1.00.00 | 5 of 8 | Electrical Single line diagram for FGD Package<br>Drg. no. 0011-109-POE-J-001/A-E | Electrical Single line diagram for FGD Package<br>Drg. no. 0011-109-POE-J-001/A/B/C<br><br>Revised Drg. is attached at Part-E. |
| 84. | SECTION – VI, PART-A | SUB-SECTION-III-B ELECTRICAL SYSTEM/ EQUIPMENT | 1.02.00 | 1 of 6 | **HT/ LT SWITCH GEAR**<br>HT and 415V Switchgear / Motor control centers (as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001) Busduct / Cable (as applicable), distribution boards, AC/DC fuse boards, LDB, local emergency push button stations for all drives energized from MCC's under contractor scope and local motor starters (for ventilation fans) as required for plant and equipment in contractor's scope. | **HT/ LT SWITCH GEAR**<br>HT and 415V Switchgear / Motor control centers (as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001) Busduct / Cable (as applicable), distribution boards, AC/DC fuse boards, LDB, local emergency push button stations for all drives and local motor starters (for ventilation fans) as required for plant and equipment in contractor's scope.<br>**HT Switchgear**- All HT switchboards shall be provided with one spare motor feeder and one transformer feeder on each |

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| | | | | | | section as spares.<br><br>**LT Switchgear-** All LT Switchgears, Motor Control Centers (MCCs) & AC/DC distribution boards, etc. shall have at least twenty per cent (20%) or minimum two (whichever is higher) fully equipped switch fuse modules of each rating as spares, uniformly distributed over different vertical sections.<br><br>In addition, all LT Switchgears, MCCs and AC distribution boards shall have as spares at least twenty per cent (20%) of starter modules/MCCB modules or at least one module (whichever is higher) of each rating range of the selection tables (Clause no.43.00.00) of Tech. Specification Part-B, Sub-Section E-10, equipped for the rating of the largest auxiliary fed from that range. |

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| 85. | SECTION – VI, PART-A | SUB-SECTION-III-B ELECTRICAL SYSTEM/ EQUIPMENT | 1.02.00 | 1 of 6 | **DC SYSTEM**<br>**Battery and Battery Charger**<br>Lead acid plante type/ Nickel Cadmium batteries and Float cum boost chargers for plant and equipment in the scope of the contractor, as per system requirement. The DC system (Battery and Charger) shall be supplied to cater to various DC loads in the plant. The design and sizing criteria shall be as detailed out in the chapter B-0 Part-B of Technical specifications | **DC SYSTEM**<br>**Battery and Battery Charger**<br>Lead acid plante type/ Nickel Cadmium batteries and Float cum boost chargers for plant and equipment in the scope of the contractor, as per system requirement. The DC system (Battery and Charger) shall be supplied to cater to various DC loads in the plant. The design and sizing criteria shall be as detailed out in the Sub-section-II- E1 Part-B of Technical specifications |
| 86. | SECTION – VI, PART-B | SUB-SECTION-II-E1 GENRAL ELECTRICALSPECIFICATION | 2.01.01 | 3 of 7 | Adequate number of auxiliary transformers shall be provided to meet the demand on 11kV, 3.3KV and 415V systems under most onerous conditions, with the criteria that each 11kV / 3.3KV / 415 V switchgear / MCC / DB shall be fed by 2x100% or 3 X 50 %, 3x100% transformers / feeders, and these shall be rated to carry the maximum | Adequate number of auxiliary transformers shall be provided to meet the demand on 11kV, 3.3KV and 415V systems under most onerous conditions, with the criteria that each 11kV / 3.3KV / 415 V switchgear / MCC / DB shall be fed by 2x100% or 3 X 50 %, transformers / feeders, and these shall be rated to carry the maximum load expected to |

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| | | | | | load expected to be imposed. | be imposed. |
| 87. | SECTION – VI, PART-B | SUB-SECTION-II-E1 GENRAL ELECTRICALSPECIFICATION | 2.02.00 | 3 of 7 | **MV Switchgears**<br>Sizing of HT Switchgears (11kV/3.3kV) shall be in accordance with Clause No. 1.00.00 of Sub-section E9 and its sub-clauses covering sizing criteria, performance / reliability criteria, layout criteria, spare capacity requirements, standardization, etc. | **MV Switchgears**<br>Sizing of HT Switchgears (11kV/3.3kV) shall be in accordance with Clause No. 1.00.00 of Sub-section E9 and its sub-clauses covering sizing criteria, performance / reliability criteria, layout criteria, spare capacity requirements, standardization, etc. |
| 88. | SECTION – VI, PART-B | SUB-SECTION-II-E1 GENRAL ELECTRICALSPECIFICATION | 2.03.00 | 3 of 7 | **LV Switchgears**<br>Sizing of LT Switchgears shall be in accordance with Clause No. 1.00.00 of Sub-section-II-E10 and its sub-clauses covering design considerations, performance / reliability criteria, spare capacity requirements, standardization, etc. | **LV Switchgears**<br>Sizing of LT Switchgears shall be in accordance with Clause No. 1.00.00 of Sub-section-II-E10 and its sub-clauses covering design considerations, performance / reliability criteria etc. |

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| 89. | SECTION – VI, PART-B | SUB-SECTION-II-E1 GENRAL ELECTRICALSPECIFICATION | 2.03.00 | 4 of 7 | **LV Switchgears**<br>…….<br>For 415V system, busduct assemblies shall be used for incoming connection from transformers to the switchboard and interconnecting sections between switchboards wherever transformer rating is 1000KVA or above | **LV Switchgears**<br>**……**<br>For 415V system, busduct assemblies shall be used for incoming connection from transformers to the switchboard and interconnecting sections between switchboards wherever transformer rating is 1000KVA or above. However, for transformers of 1000kVA rating, cable connection may also be acceptable in case of layout constraints. |
| 90. | SECTION – VI, PART-B | SUB-SECTION-II-E1 GENRAL ELECTRICALSPECIFICATION | 2.04.00 | 4 of 7 | Integration with Employer's Switchgear SCADA<br><br>All MV & LV circuit breakers shall be provided with Communicable Numerical Relays complying with IEC-61850 as specified in Sub-section II-E-09. These relays shall be integrated with Employer's Switchgear SCADA through Ethernet switches (to be supplied by Employer) mounted on each | **THIS CLAUSE DELETED.** |

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| | | | | | switchgear.<br>The circuit breaker will normally be controlled from remote control panels (DDCMIS) through closing and shunt trip coils. The control of the breakers shall also be possible from the Employer's Switchgear SCADA system. | |
| 91. | SECTION – VI, PART-B | SUB-SECTION-II-E1 GENRAL ELECTRICALSPECIFICATION | 2.05.00 | 4 of 7 | Control Philosophy<br>The Control Philosophy shall be as follows:<br>(a) All the 11 KV/ 3.3 KV & LT Incomers, Ties , Bus couplers, Transformer feeders shall be controlled from Switchgear SCADA and also from DDCMIS.<br>(b)The motor feeders shall be controlled from the DDCMIS only | Control Philosophy<br>The Control Philosophy shall be as follows:<br>a) All switchgears and MCCs shall be controlled from PLC/DCS. |

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| 92. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 1.00.00 | 1 of 39 | ……<br>**Sizing For fault Conditions**<br>Fault Level shall be the basic selection Criteria for MV switchgears. Typical Fault ratings are as detailed under Technical parameters (B-0). | ……<br>**Sizing For fault Conditions**<br>Fault Level shall be the basic selection Criteria for MV switchgears. Typical Fault ratings are as detailed under Technical parameters (sub-section-II-E1). |
| 93. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 1.00.00 | 2 of 39 | **Spare capacity and Future Requirements**<br>all MV Switchboards is provided with one spare motor feeder and one transformer feeder on each section for future requirements. | ……<br>**Deleted** |

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<table>
<tr><td colspan="2">a) SYSTEM PARAMETERS</td><td></td><td></td><td></td></tr>
<tr><td>1</td><td>Nominal System voltage</td><td>11 kV</td><td>6.6 kV</td><td>3.3 kV</td></tr>
<tr><td>2</td><td>Highest System voltage</td><td>12 kV</td><td>7.2 kV</td><td>3.6 kV</td></tr>
<tr><td>3</td><td>Rated Frequency</td><td>50 Hz</td><td>50 Hz</td><td>50 Hz</td></tr>
<tr><td>4</td><td>Number of phases/ poles</td><td>Three</td><td>Three</td><td>Three</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">System neutral earthing</td><td colspan="3">Earthed through Resistance to limit fault current to</td></tr>
<tr><td>600A</td><td>600A</td><td>600A</td></tr>
<tr><td>6</td><td colspan="3">One minute power frequency withstand voltage</td><td></td></tr>
<tr><td></td><td>- for Type tests</td><td>28</td><td>20</td><td>10</td></tr>
<tr><td></td><td>- for Routine tests</td><td>28</td><td>20</td><td>10</td></tr>
<tr><td>7</td><td>1.2/50 microsecond Impulse withstand voltage</td><td>75 kV (peak)</td><td>60 kV(peak)</td><td>40 kV(peak)</td></tr>
</table></td></tr>
</table>

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| | | | | |
|---|---|---|---|---|
| 8 | Maximum system fault level including initial motor contribution | 40 kA (rms) | 40 kA (rms) | 40 kA (rms) |
| 9 | Short time rating for bus bars, ckt. breakers, current transformers and swgr. Assembly. | 40 kA (rms) for one (1) sec. | 40 kA (rms) for one (1) sec. | 40 kA (rms) for one (1) sec. |
| 10 | Dynamic withstand rating | 100 kA (peak) | 100 kA (peak) | 100 kA (peak) |
| 11 | IAC Rating | 40 KA,1 sec | | |
| 11 | Control supply voltage | | | |
| | - Trip and closing coils | 240V DC | 240V DC | 240 V DC |
| | - Spring charging motor | 240V DC | 240V DC | 240 V DC |
| | - Space heaters | 240 V AC single phase with neutral solidly earthed | | |

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| | | | | | | 12 Maximum ambient air temperature: 50 deg. C / 50 deg. C<br>b) BUS BARS<br>1. Continuous current rating at 50°C ambient: As Per System requirements and preferably the current ratings shall be 2700 amp, 2500 Amp, 2000Amp, 1600 Amp and 1000 Amp.<br>2. Temper Rise allowed above ambient: 40° C for plain joints 55° C for Silver plated joints.<br>c) SWGR. CUBICLE CONSTRUCTIONAL REQUIREMENTS<br>1. Color finish<br>Exterior: RAL9002 (Main body) RAL 5012 (Extreme end covers)<br>2. Cable entry<br>a) Power Cables: Bottom<br>b) Control Cables: Bottom<br>3. Bus duct entry: Top<br>4. Earthing conductor: Galvanized steel strip |

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| | | | | | |
|---|---|---|---|---|---|
| 5 | Service Continuity of swgrs(as per IS/IEC 62271-200) | LSC2B-PM | | | |
| d) | **CIRCUIT BREAKERS** | | | | |
| 1. | The circuit breakers current rating shall be selected from the load current given in SLD which is at an ambient of 50$^0$ C. | | | | |
| 2. | Short circuit breaker Current | **11 kV** | **6.6 kV** | **3.3 kV** | |
| | a) A.C. component | 40kA | 40 kA | 40KA | |
| | b) D.C. component | As per IS: 13118 or IEC-62271 | | | |
| 3. | Short Circuit making current | 100 kA (peak) | 100 kA (peak) | 100 kA (peak) | |
| 4. | Operating Duty | B-3 Min-MB-3 Min-MB | | | |
| 5. | Total break time | Not more than 4 cycles | | | |
| 6. | Total make time | Not more than 5 cycles | | | |
| 7. | Operating Mechanism | Motor wound spring charged stored energy type as per IEC-62271 | | | |
| e) | **CURRENT TRANSFORMER** | | | | |

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| | | | | | | 1. Class of Insulation: Class E or better<br>2. Rated output of each: Adequate for the relays and devices connected, but not less than five (5) VA.<br>3. Accuracy class:<br>Protection & Measurement: Class PS for differential & REF and core balance CTs; 5P20 for other protection CTs. Required Accuracy for metering is 0.2s for feeders as marked in SLD<br>4. Minimum primary earth fault current to be detected by core balance current Transformer: 3 Amperes<br>**f) VOLTAGE TRANSFORMERS**<br>1. Rated Voltage Factor: 1.2 continuous for all VTs, and 1.9 for 8 hours for star connected VTs.<br>2. Class of insulation: Class E or better |

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<table>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><td>3.</td><td>Other parameters</td><td colspan="3">BUS PT-0.5 Class,VA req. adequate for application. Line PT-0.5 Class for sync./3P for door interlocks, VA req. adequate for application. 0.2 class PT for defined feeders as per SLD for metering application, VA req. adequate for application.</td></tr>
<tr><td colspan="5">g) H.V. FUSES</td></tr>
<tr><td>1.</td><td>Voltage class</td><td colspan="2">6.6KV</td><td>3.3 KV</td></tr>
<tr><td>2.</td><td>Rupturing Capacity</td><td colspan="2">Adequate for 100 kA (peak)</td><td>Adequate for 100 kA (peak)</td></tr>
<tr><td>3.</td><td>Rated current</td><td colspan="2">As per application</td><td></td></tr>
<tr><td colspan="5">h) SURGE ARRESTERS (FOR MOTOR FEEDERS)</td></tr>
<tr><td></td><td></td><td>11 kV</td><td>6.6 KV</td><td>3.3 KV</td></tr>
<tr><td>1.</td><td>Nominal discharge Current (8x20 µs)</td><td>5kA</td><td>5kA</td><td>5kA</td></tr>
<tr><td>2.</td><td>Max. system voltage (rms)</td><td>12 kV</td><td>7.2 KV</td><td>3.6 KV</td></tr>
</table>
</td></tr>
</table>

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| | | | | |
|---|---|---|---|---|
| 3. | Rated Voltage of Surge arrestor | 12 KV (phase to phase) | 7.5 KV (phase to phase) | 4.5 KV (phase to phase) |
| 4. | Max allowable Residual voltage at nominal discharge current | 40 kV | 25 kV | 15 kV |
| 5. | Mounting | Inside panel | Inside panel | Inside panel |
| i) | **CONTACTORS :** | | | |
| 1. | Nominal System Voltage | 6.6 kV | | 3.3 KV |
| 2. | Highest System Voltage | 7.2 kV | | 3.6 KV |
| 3. | Rated Frequency | 50 HZ | | 50 Hz |
| 4. | Rated Continuous Current at 50°C ambient | Current rating shall be selected appropriate for the load current. | | |
| 5. | Control Supply Voltage | 240V DC unearthed | | |

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| | | | | | | 6. Utilisation category: AC-3 |
| 95. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 3.00.00 | 6 of 39 | **h) SURGE ARRESTERS (FOR MOTOR FEEDERS)**<br>3. Rated Voltage of Surge arrestor<br>12 KV for 11 KV<br>And 4.5 KV for 3.3 KV | **h) SURGE ARRESTERS (FOR MOTOR FEEDERS)**<br>3. Rated Voltage of Surge arrestor<br><br>12 KV(Phase to Phase) for 11 KV<br>And 4.5 KV (Phase to Phase) for 3.3 KV |

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| 96. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 4.5.1 | 11 of 39 | The circuit breaker / contactor will normally be controlled from remote control panels (DDCMIS) as well as from Switchgear SCADA System (via Numerical Relays) through closing and shunt trip coils. | The circuit breaker / contactor will normally be controlled from remote control panels (PLC/DCS) (via Numerical Relays) through closing and shunt trip coils. |
| 97. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 4.5.1 | 15 of 39 | (a) All switchboards shall be provided with separate LV panels at both the extreme ends which shall house the control & space heater supply distribution system, Ethernet switches (provided by employer) and other LV equipment common for the board.<br><br>(e) Power Supply to Numerical Relay and Ethernet switch shall be an independent circuit with switch and fuse tapped from the panel DC supply….. | (a)Bus PT Panel shall house the control & space heater supply distribution system and other LV equipment common for the board.<br><br>e) Power Supply to Numerical Relay shall be an independent circuit with switch and fuse tapped from the panel DC supply….. |

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| | | | | | | |
| 98. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 5.1.4 | 19 of 39 | (d) Board IED ( Switchgear Control Unit)-32BI + 32 BO | DELETED |

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| 99. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 5.1.7 | 19 of 39 | All the numerical relays shall have communications on three ports, local front port communication to laptop and dual ports on IEC 61850 to communicate with the employer's data concentrator through LAN. The dual IEC 61850 ports shall be connected to two separate Ethernet switches (provided by employer) to form part of the Switchgear SCADA. | All the numerical relays shall have communications on two ports, local front port for communication to laptop and one RJ45 port on IEC 61850. |
| 100. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 5.3.1 | 22 of 39 | Control of breakers / vacuum contactors shall be carried out from the HMI station of Switchgear SCADA system through the LAN and the numerical relays as well as from DDCMIS through hardwired control commands in the form of 24V DC signal. Preferably, binary input of all relays shall be configurable to accept 24V DC signals directly from DDCMIS and no separate coupling relays shall be | Control of breakers / vacuum contactors shall be carried out from PLC/DCS through hardwired control commands in the form of 24V DC signal. Preferably, binary input of all relays shall be configurable to accept 24V DC signals directly from DDCMIS and no separate coupling relays shall be provided. |

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| | | | | | provided. | |
| 101. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 5.3.8 | 23 of 39 | The alarm / status of each individual protection function and trip operation shall be communicated to the Switchgear SCADA system. | DELETED |

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| 102. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 5.4.00<br>5.4.1 | 23 of 39 | **NETWORKING**<br>Adequate space in the LV panel shall be identified for mounting of at least 2 Nos of employer's Ethernet Switches (19" rack mounting) in all switchgears. Further, mounting of Ethernet switch in the above compartment and inter-panel wiring of Ethernet cable for connection of all numerical relays on the switchgear to the Ethernet switches shall be in the contractor's scope. Arrangement to provide required control supply to Ethernet switch shall be made in the switchgear. | DELETED |

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| 103. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 6.1.00 | 25 of 39 | **…….**<br>For all important components like Surge Arrestors and Numerical relays, Ethernet switches, Data concentrators & Fibre Optic cables, the contractor shall submit the reports of all the type tests as per applicable standards and carried out not earlier than ten years prior to the date of bid opening.<br>….. | …<br>For all important components like Surge Arrestors and Numerical relays, the contractor shall submit the reports of all the type tests as per applicable standards and carried out not earlier than ten years prior to the date of bid opening.<br>……. |
| 104. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 7.0.00 | 27 of 39 | **Training workshop at site for Switchgear**<br><br>Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of MV Switchgears.<br><br>The scope shall include Two No's of MV Switchgear workshops and Training for a batch of 20 Engineers and a separate batch of 20 supervisors/technicians for two(2) days in each workshop | **Training workshop at site for Switchgear**<br><br>Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of MV Switchgears.<br><br>The scope shall include one number of MV Switchgear workshop and Training for a batch of 20 Engineers and a separate batch of 20 supervisors/technicians for two (2) days at Project site. One day |

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| | | | | | at Project site. One day shall be for class-room training & One day shall be for hands-on training on MV Switchgears. One such Workshop shall be organized before the commissioning of First MV Switchboard and the Second workshop shall be conducted before Unit Commissioning. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc. | shall be for class-room training & One day shall be for hands-on training on MV Switchgears. The workshop shall be organized before the commissioning of First MV Switchboard. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc. |
| 105. | SECTION – VI, PART-B | SUB-SECTION-II-E9 HT SWITCHGEAR | 8.0.00 | 28 of 39 | **Training workshop at site for Numerical Relay**<br>Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of Numerical Relays and trouble shooting.<br>The scope shall include Two No's of Numerical Relay workshops and Training for a batch of 20 Engineers at Project Site for 2 days in each of workshop at project site. | **Training workshop at site for Numerical Relay**<br>Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of Numerical Relays and trouble shooting.<br>The scope shall include one number of Numerical Relay workshops and Training for a batch of 20 Engineers at Project Site for 2 days at project site. One day shall be for class-room |

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| | | | | | One day shall be for class-room training & One day shall be for hands-on training on Numerical Relays. One such Workshop shall be organized before the commissioning of First MV Switchboard and the Second workshop shall be conducted before Unit Commissioning. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems | training & One day shall be for hands-on training on Numerical Relays. The workshop shall be organized before the commissioning of First MV Switchboard. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc. |
| 106. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 1.01.01 | 1 of 58 | Lighting load of 50 kVA (Minimum) shall be considered on each section of main switchgears with incomer from transformer as indicated in the tender SLD. | Lighting load of 50 kVA (Minimum) shall be considered on each section of main switchgears with incomer from transformer. |

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| 107. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 1.03.00 | 2 of 58 | Spare capacity and Future Requirements<br><br>All LV Switchboard shall be provided with spare feeders / modules as specified in relevant clause of Part-A of Technical Specification. | DELETED |
| 108. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 1.04.00 | 2 of 58 | It shall be preferred to have all LV Switchboards for the entire plant from a single manufacturer from maintainability and spares management point of view. | DELETED |
| 109. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 1.05.00 | 2 of 58 | (f) Separate control cables shall be laid for EPB (Emergency/Local Push Button) status from EPB to Switchgear for the Switchgear and DCS. | (f) Separate control cables shall be laid for EPB (Emergency/Local Push Button) status from EPB to Switchgear for the Switchgear and PLC/DCS. |

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| 110. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 4.25.00 | 12 of 58 | Adequate space in a separate compartment shall be identified for mounting of Ethernet Switch (19" rack mounting), in all switchgears having numerical relays. Further, mounting of Ethernet switch in the above compartment at site and provision of inter-panel wiring (Cat5e Ethernet / Fibre Optic) for connection of numerical relays to Ethernet switch shall be in the contractor's scope. Arrangement to provide required control supply (110 V / 220 V DC) to Ethernet switch shall be made in the switchgear. | **DELETED** |
| 111. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 11.00.00 | 18 of 58 | **TELESCOPIC TROLLEY**<br>**.....**<br>The quantity of telescopic trolleys to be supplied shall be 2 Nos. per switchgear room. | **TELESCOPIC TROLLEY**<br>**.....**<br>The quantity of telescopic trolleys to be supplied shall be 1 No. per switchgear room. |

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| 112. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.00.00 | 20 of 58 | **Numerical relays & networking** | **Numerical relays** |
| 113. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.01.00 | 20 of 58 | **…….**<br>These relays shall be connected to the Switchgear SCADA System, through Ethernet switches……. | **…….**<br>**DELETED**<br>**……** |
| 114. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.02.00 | 21 of 58 | Control of circuit breakers shall be carried out from DDCMIS through hardwired control commands in the form of 24V DC signal. Preferably, binary input of all relays shall be configurable to accept 24V DC signals directly from DDCMIS and no separate coupling relays shall be provided…… | Control of circuit breakers shall be carried out from PLC/DCS through hardwired control commands in the form of 24V DC signal. Preferably, binary input of all relays shall be configurable to accept 24V DC signals directly from PLC/DCS and no separate coupling relays shall be provided. |

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| 115. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.03.00 | 21 of 58 | Each numerical relay shall be connected to the Ethernet switch(in Employers's scope) provided in the Switchgear through Cat5e Ethernet /FO cable. Ethernet Switches shall be connected through Fibre Optic cable to form a ring network. | **DELETED** |
| 116. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.04.00 | 21 of 58 | The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings. The alarm / status of each of protection function and trip operation shall be communicated to Switchgear SCADA / DDCMIS. The numerical relays shall have built in feature / hardware interface to provide such inputs to Switchgear SCADA / DDCMIS for analog / digital values. | The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance. |

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| 117. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.05.00 | 21 of 58 | The required .ICD / .CID files of the Numerical relays under the scope of this package for the integration with the SCADA shall be provided by the Numerical relay vendor along with necessary engineering support. | **DELETED** |
| 118. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.11.00 | 22 of 58 | All the numerical relays shall have communications on three ports, local front port for communication with laptop and dual ports on IEC 61850 to communicate with the Switchgear SCADA System. | All the numerical relays shall have communications on two ports, local front port for communication with laptop and one RJ45 port on IEC 61850. |
| 119. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.26.00 | 23 of 58 | Numerical relays shall have feature for Time synchronization through the Switchgear SCADA System. The resolution of time synchronization shall be +/- 1.0 millisecond or better throughout the entire system. | Numerical relays shall have feature for Time synchronization. The resolution of time synchronization shall be +/- 1.0 millisecond or better throughout the entire system. |

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| 120. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.27.00 | 23 of 58 | Relays & Ethernet switches shall be suitable to accept both AC & DC supplies with range 110V or 220V with tolerance of 70 % to 120 % of rated voltage & shall be finalized during detailed engineering. | Relays shall be suitable to accept both AC & DC supplies with range 110V or 220V with tolerance of 70 % to 120 % of rated voltage & shall be finalized during detailed engineering. |
| 121. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 18.27.00 | 23 of 58 | Bus no volt condition shall be configured to an output contact of the relay of incomers for suitably interfacing with DDCMIS wherever required. | Bus no volt condition shall be configured to an output contact of the relay of incomers for suitably interfacing with PLC/DCS wherever required. |
| 122. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 19.08.00 | 24 of 58 | The alarm/status of each individual protection function and trip operation shall be communicated to Switchgear SCADA / DDCMIS. | **DELETED** |

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| 123. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 19.12.00 | 24 of 58 | Required No. of extra binary inputs shall be provided in the numerical relay for digital inputs from critical outgoing MCCB feeders on that switchgear section | **DELETED** |
| 124. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 19.13.00 | 24 of 58 | Circuit-breaker status, protection status, etc. required for control logics shall be hardwired to DDCMIS…… | Circuit-breaker status, protection status, etc. required for control logics shall be hardwired to PLC/DCS…… |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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|---|---|---|---|---|---|---|
| 125. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 19.14.01 | 24 of 58 | The contractor shall arrange for training on design, engineering, Commissioning and operation & maintenance of LV Switchgear, Numerical relays and Switchgear networking system for a duration of one (1) man-months. | **Training workshop at site for Switchgear**<br><br>Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of LT Switchgears.<br><br>The scope shall include one number of LT Switchgear workshop and Training for a batch of 20 Engineers and a separate batch of 20 supervisors/technicians for two (2) days at Project site. One day shall be for class-room training & One day shall be for hands-on training on LT Switchgears. The workshop shall be organized before the commissioning of First LT Switchboard. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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|---|---|---|---|---|---|---|
| 126. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 19.14.02 | 24 of 58 | The scope shall include training for a batch of engineers and a separate batch of Supervisors/Technicians at Project Site. One such Workshop shall be organized before the commissioning of First LV Switchboard and the second workshop shall be conducted before final system Commissioning. Owner shall provide the required Infrastructure such as Training Conference room, Projection systems etc. | **Training workshop at site for Numerical Relay**<br>Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of Numerical Relays and trouble shooting.<br>The scope shall include one number of Numerical Relay workshops and Training for a batch of 20 Engineers at Project Site for 2 days at project site. One day shall be for class-room training & One day shall be for hands-on training on Numerical Relays. The workshop shall be organized before the commissioning of First LT Switchboard. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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| 127. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 31.00.00<br>31.01.00<br>31.02.00<br>31.03.00<br>31.04.00<br>31.05.00<br>31.06.00<br>31.07.00<br>31.08.00<br>31.09.00<br>31.10.00<br>31.11.00 | 31 & 32 of 58 | **BUS TRUNKING SYSTEM (SANDWICH TYPE BUSDUCT)** | **DELETED** |
| 128. | SECTION – VI, PART-B | SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS | 38.04.00 | 34 of 58 | Type test reports for the following tests on the model of the Numerical relays, Ethernet switches shall be submitted for Employer's review. | Type test reports for the following tests on the model of the Numerical relays shall be submitted for Employer's review. |
| 129. | SECTION – VI, PART-B | SUB-SECTION-II-E11 DIESEL GENERAT | 5.03.00 | 3 0F 20 | Owner shall provide two (2) number…….<br>…. The alternator outgoing supply of DG set shall be fed | **Bidder** shall provide two (2) number…….<br>The alternator outgoing supply of DG set shall be fed into **bidder's** |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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| | | ORS | | | into employers breaker panel. | breaker panel. |
| 130. | SECTION – VI, PART-B | SUB-SECTION-II-E11 DIESEL GENERATORS | 6.01.00 | 4 of 20 | All DG…… It shall also have auto initiation through command from remote from owner's panel……included in the offer | All DG…. It shall also have auto initiation through command from remote from **bidder's** panel……included in the offer |
| 131. | SECTION – VI, PART-B | SUB-SECTION-II-E11 DIESEL GENERATORS | 7.10.03 | 7 OF 20 | (I) Earth fault (alarm) input from owners switchgear | (i) Earth fault (alarm) input from **bidder's** switchgear |
| 132. | SECTION – VI, PART-B | SUB-SECTION-II-E11 DIESEL GENERATORS | 7.11.00 | 8 of 20 | Suitable 4-20mA transducers with dual output shall be provided in the control panel for voltmeter & frequency meter for owners use at remote | Suitable 4-20mA transducers with dual output shall be provided in the control panel for voltmeter & frequency meter for **bidder's** use at remote |
| 133. | SECTION – VI, PART-B | SUB-SECTION-II-E11 DIESEL GENERAT | 7.12.00 | 8 of 20 | The bidder is required to provide coupling relays (with diodes) having 24V DC energising coil in the control panel for the followings for | The bidder is required to provide coupling relays (with diodes) having 24V DC energising coil in the control panel for the followings for **bidder's** use |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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| | | ORS | | | owner's use | |
| 134. | SECTION – VI, PART-B | SUB-SECTION-II-E11 DIESEL GENERATORS | 7.14.00 | 8 of 20 | Provision for following status/ signal for Employers information shall be provided in the DG control panel for both main & standby DG Sets: | Provision for following status/ signal for **Bidder's** information shall be provided in the DG control panel for both main & standby DG Sets: |
| 135. | SECTION – VI, PART-B | SUB-SECTION-II-E11 DIESEL GENERATORS | 3.00.00 | 2 of 20 | Technical Requirements:-<br>Fuel service tank:-8 hours running | Technical Requirements:-<br>Fuel service tank:- 990 litres |
| 136. | SECTION – VI, PART-B | SUB-SECTION-II-E11 DIESEL GENERATORS | 7.04.00 | 5 of 20 | A tinned copper/ aluminium bar of adequate dimension shall be provided for earth connection complete with nuts and bolts as required for external connection to Employers earth grid | A tinned copper/ aluminium bar of adequate dimension shall be provided for earth connection complete with nuts and bolts as required for external connection to **Bidder's** earth grid |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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| 137. | SECTION – VI, PART-B | SUB-SECTION-II-E15 STATION LIGHTING | 4.00.00 | 5 of 19 | 5) While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations | 5) **Different Lighting Systems envisaged for various plant areas are indicated in Annexure-E2:** While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations |
| 138. | SECTION – VI, PART-B | SUB-SECTION-II-E15 STATION LIGHTING | | 18of 19 19 of 19 | NA | **Annexure –E2** attached |
| 139. | SECTION – VI, PART-A | SUB-SECTION-IIIB-ELECTRICAL SYSTEM/EQUIPMENT | 1.08.00 | 2 OF 6 | 2) Contractor scope shall include…in the FGD area as shown in Drg no :- 0011-999-POC-F-001… and suitability…. | 2) Contractor scope shall include…in the FGD area as shown in **GLP drawing of respective plant**….and suitability…. |

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| 140. | SECTION – VI, PART-B | SUB-SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION | 9.00.00 | 23 OF 23 | e) NA | e) The cable entry and exit from switchgear room shall be from 1.5 mtr (minimum) above FGL |
| 141. | SECTION – VI, PART-B | SUB-SECTION-II-E12 Outdoor Transformer | 7.00.00 | | **NEW CLAUSE ADDITION** | Specification for Dry type (indoor transformers) Attached as **Annexure-E3** |

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| 142. | Part-B, Section-VI | Sub-Section-I-M7 | 3.01.00 | 3-4 of 32 | **A. General System Description**<br>The wastewater stream…… …….in the tender.<br><br><u>Brine Concentrator</u><br>The design of brine concentrator……..produce solids.<br><br><u>Crystallizer System</u><br><br>Waste water……Vapour compressor | **A. General System Description**<br>The wastewater stream…… …….in the tender.<br><br><u>Brine Concentrator</u><br>The design of brine concentrator……..produce solids.<br><u>Vacuum/Low temperature operation system</u><br>Vacuum/Low temperature operation, where no seed slurry is added and wastewater boil in low temperature due to vacuum condition, is also acceptable provided such system meets the provenness criteria specified in tender.<br>In case, the Bidder provides such a system, all other associated system etc. shall be provided in line with the reference project which meets the provenness criteria proposed by the vendor. Further, the contractor shall provide all necessary support documents like P&IDs, Process |

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| | | | | | | calculation, Equipment Layouts, etc. of the Reference Project during detail engineering & same equipment/system shall be provided for these projects also as a minimum.<br>Further, Contractor shall also comply with all other requirements like Design criteria, Redundancy of equipment, MOC, Guarantee etc. as specified in this Technical specification.<br><br><u>Crystallizer System</u><br><br>Waste water……Vapour compressor |
| 143. | Part-A, Section-VI | Sub-Section-III-A6 | 1.02.00 | 1 of 3 | **Evaporative concentration system**<br>The softened wastewater…… vacuum pumps(if applicable), Seeding system, Chemical feeding system, ……..provided as per system requirement. | **Evaporative concentration system**<br>The softened wastewater……. vacuum pumps(if applicable), Seeding system/ Vacuum/Low temperature operation system , Chemical feeding system, ……..provided as per system requirement. |

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| 144. | VI/A | **III-A1** | 2 of 9 | 2.04.00 | Clean gas from the absorber shall be taken to the Wet Chimney, to be provided by the Contractor, through three stage mist eliminators. The contractor shall terminate the flue gas duct (at a suitable point on the common flue gas duct to chimney-upstream of the chimney terminal point and outside the chimney). Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper & Gate is included in the scope of the Contractor. | Clean gas from the absorber shall be taken to the Wet Chimney, to be provided by the Contractor, through three stage mist eliminators. Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper & Gate is included in the scope of the Contractor. |
| 145. | VI/A | **III-A1** | 1 of 9 | 1.03.00 | The FGD system ……..**Lot 1A** Project. The contractor shall also supply an auxiliary absorbent tank, common for the two units, for storage of absorber slurry of one unit. The contractor's scope……..system. | The FGD system ……..**Lot 1A** Project. The contractor shall also supply an auxiliary absorbent tank, common for all the units, for storage of absorber slurry of one unit. The contractor's scope……..system. |

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| 146. | VI/A | III-A1 | 2 of 9 | 2.06.00 | The gypsum from the absorber(s)……..provided. Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor (in Employers scope). The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor being provided by the Employer. | The gypsum from the absorber(s)……..provided. Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor. The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor to be provided by the **Contractor**. |
| 147. | VI/A | III-A1 | 5 of 9 | 7.00.00 | **PROCESS WATER & COOLING WATER STORAGE & PUMPING SCHEME (FOR 2X800 MW)** | **PROCESS WATER & COOLING WATER STORAGE & PUMPING SCHEME** |
| 148. | VI/A | III-A1 | 6 of 9 | 7.01.01 | 2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. | 2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (**for example** total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. |

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| 149. | VI/A | **III-A1** | 6 of 9 | 7.02.00 | 2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump ……Technology Collaborator. | 2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (**for example** total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump ……Technology Collaborator. |
| 150. | VI/A | **III-A1** | 5 of 9 | 6.01.00 | The employer shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. | The **Contractor** shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. |
| 151. | VI/B | **I-M1** | 7 of 51 | 3.03.09 | The dampers shall be pneumatically operated and controlled from the controlroom. Provision shall be made for giving signal automatic bypass controls of the absorber in case of failure of the absorber spray system or the GGH. The dampers ……therimofthehand wheel. | The dampers shall be pneumatically operated and controlled from the controlroom. Provision shall be made for giving signal automatic bypass controls of the absorber in case of failure of the absorber spray system. The dampers ……therimofthehand wheel. |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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| 152. | VI/B | **I-M1** | 20 of 51 | 5.06.23 | It should be possible to discharge the absorber sump into the emergency drain tank within 2 hours. | It should be possible to discharge the absorber sump into the **Auxiliary Absorbent** tank within 2 hours. |
| 153. | VI/B | **I-M1** | 29 of 51 | 7.08.01 | The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sumpIt should be possible to discharge the each absorber into the emergency drain tank within 2 hours. | The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump. It should be possible to discharge the each absorber into the **Auxiliary Absorbent** tank within 2 hours. |
| 154. | VI/B | **I-M1** | 3 of 51 | 1.03.08 | In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, flue gas damper upstream & downstream of FGD, Process water pump & lube oil system of Booster Fan & Ball Mill) which may cause irreversible damage to the FGD System shall be connected to the emergency power supply system to be provided by the Contractor. Bidder shall furnish a list of all such Auxiliaries in their bid proposal. | In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, Process water pump & lube oil system of Booster Fan & Ball Mill) which may cause irreversible damage to the FGD System shall be connected to the emergency power supply system to be provided by the Contractor. Bidder shall furnish a list of all such Auxiliaries in their bid proposal. |

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| 155. | VI/B | I-M1 | 39 of 51 | 16.01.03 | All flue gas ducts shall also be designed for ± 660 mm w.g., or maximum conceivable pressure of the relevant fans, whichever is higher at 67% of yield strength of material | | The flue gas duct upto Booster Fan inlet shall be designed for ± 660 mm w.g. at 67% of yield strength of material. The flue gas duct from Booster Fan outlet shall be designed for + 660 mm& - 150 mm wg or maximum conceivable pressure of the Booster Fan, whichever is higher, at 67% of yield strength of material. | |
| 156. | VI/B | I-M1 | 8 of 51 | 4.01.01 3 (iii) | Pressure at Booster Fan suction | 0 mmWc | Pressure at Terminal Point before Booster Fan suction | 0 mmWc |
| 157. | VI/B | I-M1 | 16 of 51 | 5.04.00 | Each absorber ……..<br>The pumps shall be designed to meet the stipulations of Clause No.9.00.00 of this Sub-Section. | | Each absorber ……..<br>The pumps shall be designed to meet the stipulations of Clause No.8.00.00 of this Sub-Section. | |
| 158. | VI/B | I-M1 | 20 of 51 | 5.06.22 | In case of Spray Tower System, Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps. In case Bubbling type, | | **In case of Spray Tower System, Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps. In** | |

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| | | | | | suction strainers shall be installed at the suction side of Gas Cooling Pumps. For the agitators a flushing system for start ups shall be provided. | **case Bubbling type, suction strainers shall be installed at the suction line side of Gas Cooling Pumps. The Screens shall be made of made of Alloy 59 /C276 or abrasion resistant FRP/Polypropylene (in case Contractor/Collaborator has proven experience). For the agitators a flushing system for start ups shall be provided.** |
| 159. | VI/B | **I-M1** | 20 of 51 | 5.06.21 | The bottom ..... for this. The bottom of the absorber sump shall be designed in such a way that complete drainage of the absorption liquid/slurry is possible and isaccessible without damage of lining/rubber. | The bottom ..... for this. The bottom of the absorber sump shall be designed in such a way that complete drainage of the absorption liquid/slurry is possible and is accessible without damage of lining. |
| 160. | VI/B | **I-M1** | 22 of 51 | 6.03.05 | In addition, a hand wheel with proper access shall also be provided for manual operation of the gate. The force at the rim of the hand wheel shall not exceed 35 kg with bunker full of coal. | In addition, a hand wheel with proper access shall also be provided for manual operation of the gate. The force at the rim of the hand wheel shall not exceed 35 kg with bunker full of **limestone**. |

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| 161. | VI/B | **I-M1** | 22 of 51 | 6.05.01 (ii) | Flow | 110% of limestone requirement of two absorbers at Design point | Flow | 110% of limestone requirement of **all the** absorbers at Design point |
| 162. | VI/B | **I-M1** | 24 of 51 | 6.07.03 | The limestone …….. load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 10 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends. | | The limestone …….. load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 6 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends. | |
| 163. | VI/A | V | 3 of 26 | 2.00.00 | The Flue Gas Desulphurisation (FGD) System FOR MOUDA-II 2X660 MW, TANDA-II 2X660 MW, NABINAGAR-I 3X660 MW, MEJA-I 2X660 MW & BARH-I 3X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:<br><br>……and 273.15 K. | | The Flue Gas Desulphurisation (FGD) System FOR MOUDA-II 2X660 MW, TANDA-II 2X660 MW, NABINAGAR-I 3X660 MW & BARH-I 3X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:<br><br>…… and 273.15 K. | |

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| 164. | VI/A | V | 1 of 26 | 1.00.00 7 (iii) | $H_2O$ (% v/v wet) | 10.910 | 3.958 | $H_2O$ (% v/v wet) | 10.910 | 13.958 |
| 165. | VI/A | V | 4 of 9 | 4.01.04 | 2x100% Centrifugal/ positive displacement type oxidation blowers / compressors. | | | 2x100% electric motor driven, single-stage, integrally geared, single or dual vane centrifugal type oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blowers will be used for supplying a variable volume of air to the absorber reaction tank | | |
| 166. | VI/B | I-M1 | 8.05.00 | 30 of 51 | The pump casing should be radially split to allow easy removal of impeller. | | | In case of pump with rubber lined casing, the casing should be radially split to allow easy removal of impeller. | | |

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| 167. | VI/B | **I-M1** | 30 of 51 | 8.07.00 | For absorber recirculation service a Silicon carbide impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation for similar service. | For absorber recirculation service a Silicon carbide/**hi-chrome** impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation for similar service |

| SL. NO. | SPECIFICATION REFERENCE | | | | EXISTING | READ AS |
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| | SEC/ PART | SUB SEC. | PAGE NO. | CLAUSE NO. | | |
| 168. | VI/B | I-M1 | 11 of 51 | 4.04.00 | **ID fans:**<br>Fan casing material thickness: Abrasion and wear resistant, high BHN steel having minimum 8.0mm thickness or 12mm mild steel with liner of thickness 10mm (min.) | **ID fans:**<br>Fan casing material thickness: Abrasion and wear resistant, high BHN steel having minimum 8.0mm thickness or 12mm mild steel with liner of thickness 10mm (min.) Alternatively, 22 mm thickness casing of mild steel is also acceptable. |

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<table>
<tr><th colspan="2">Gates in Flue Gas System</th></tr>
<tr><td>1. Seals</td><td>1 set of each type<br>(Set means complete replacement for one gate)</td></tr>
<tr><td>2. Actuator</td><td>1 no. of each type & rating</td></tr>
<tr><td>3. Expansion joint</td><td>1 number for each type and size</td></tr>
<tr><td>4. Seals for guillotine gate(Both port side and bonnet side) (In case Gates are provided)</td><td>1 set for each gate</td></tr>
</table>
</td><td>
<table>
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<tr><td>1. Seals</td><td>1 set of each type & size<br>(Set means complete replacement for one gate)</td></tr>
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</table>
</td></tr>
<tr><td>170.</td><td>VI/A</td><td>VI</td><td>20 of 24</td><td>4.02.00 (vi)</td><td>Waste Water<br><br>The Contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10m$^3$/hr</td><td>Waste Water<br><br>The Contractor guarantees that the maximum purge flow rate to waste water treatment system for Barh-I (3X660 MW) shall be 30 m3/hr</td></tr>
</table>

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| | | | | | averaged over a 24 hour period from each unit. | averaged over a 24 hour period and for Nabinagar (4x250 MW) shall be 20 m3/hr averaged over a 24 hour period from each unit |
| 171. | VI/B | I-M1 | 31 OF 51 | 10.01.00 | All the slurry tanks (Slurry Tanks……. in accordance with the IS:803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell ……. Coarse-screen(s) at suction-side of these pumps shall be provided. | All the slurry tanks (Slurry Tanks……. in accordance with the IS:803, latest edition. Additional Corrosion allowance of **1.5 mm** on the minimum tank shell ……. Coarse-screen(s) at suction-side of these pumps shall be provided. |
| 172. | VI/B | I-M1 | 29 OF 51 | 7.08.02 | The contractor shall provide 2 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours. | The contractor shall provide **1**x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours. |

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| 173. | VI/A | III-A1 | 4 of 9 | 6.01.00 | The employer shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. | The Contractor shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. |
| 174. | VI/A | III-A1 | 1 of 9 | 1.03.00 | The FGD system shall …….. for each **Lot 1A** Project. The contractor shall also supply an auxiliary absorbent tank, common for the two units, for storage of absorber slurry of one unit. The contractor's scope shall include the absorbers, common limestone grinding system and gypsum dewatering system. | The FGD system shall …….. for each **Lot 1A** Project. The contractor shall also supply an auxiliary absorbent tank, common for **all units in a project**, for storage of absorber slurry of one unit. The contractor's scope shall include the absorbers, common limestone grinding system and gypsum dewatering system. |
| 175. | VI/B | I-M1 | 22 of 51 | 6.05.01 | There shall be 2X100% tube mills for grinding of limestone. Each mill ……13 (min). | There shall be 2X100% wet ball mills for grinding of limestone. Each mill ……13 (min). |

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| 176. | VI/B | I-M1 | 7 of 51 | 3.03.08 | All the gates shall be designed for tight shut off. The Guillotine gate type dampers mentioned at ..... condition without the use of seal air fans of the damper. The bypass damper shall ..... minimum one type of damper of each type and size. | All the gates shall be designed for tight shut off. The Guillotine gate type dampers mentioned at ..... condition without the use of seal air fans of the damper. **The Guillotine gates shall also be provided with a 2X100% complete seal air system.** The bypass damper shall ..... minimum one type of damper of each type and size. |
| 177. | VI/A | V | 8 of 26 | 5.01.00 | A "wet Chimney" shall be .....without FGD system in operation. The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. The wet stack shall be designed as per the guidelines of EPRI Revised Wet Stack Design Guide. .....<br>.....< | A "wet Chimney" shall be .....without FGD system in operation. The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. The wet stack shall be designed as per the guidelines of EPRI Revised Wet Stack Design Guide. **Alternatively, Contractor can also provide chimney of 8 mm thick** |

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## AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

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| | | | | | 18 at Design Point | **(minimum) mild steel with Borosilicate Glass Block Lining of minimum 38 mm thickness, which should have been in successful operation for similar application in at least two (2) units, located at different locations, for a period not less than two (2) years as on the date of Techno-Commercial bid opening. In such a case, Contractor/Lining supplier shall provide a ten (10) year full replacement guarantee and fulltime onsite QA supervision, during erection & commissioning, by the supplier of the lining system.**<br><br>**External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet.**<br>.....<br>.....<br>18 at Design Point |
| 178. | VI/B | I-M1 | 6 of 51 | 3.02.04 | The duct to Absorber inlet .....thickness. The duct from Absorber outlet to bypass duct shall be made of Carbon steel of minimum 7mm thickness with 2 mm | The duct to Absorber inlet .....thickness. The duct from Absorber outlet to bypass duct shall be made of Carbon steel of minimum 7mm thickness cladded |

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| | | | | | (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. | with 2 mm (minimum) thickness Alloy C276 / Alloy 59 or better material. |
| 179. | VI/B | I-M1 | 19 of 51 | 5.06.11 | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br><br>The absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. | The complete absorber vessel (absorber oxidation tank, absorber tower & absorber outlet duct) shall be made of clad sheet of C276 / Alloy 59 (minimum 2 mm thickness) having minimum 7 mm thick carbon steel as base material. |
| 180. | VI/A | III-A1 | 6 of 9 | 8.02.00 | The contractor ……system. The Interior surface of the Sumps shall be lined with replaceable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness. | The contractor ……system. The Interior surface of the Sumps shall be lined with replaceable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness **or with vinyl ester based flake glass lining of minimum 3 mm thickness.** |

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<table>
<tr><th rowspan="2">SL. NO.</th><th colspan="4">SPECIFICATION REFERENCE</th><th colspan="2">EXISTING</th><th colspan="2">READ AS</th></tr>
<tr><th>SEC/ PART</th><th>SUB SEC.</th><th>PAGE NO.</th><th>CLAUSE NO.</th><th></th><th></th><th></th><th></th></tr>
<tr><td>181.</td><td>VI/A</td><td>VII</td><td>6 of 61</td><td>1.04.00</td><td>Absorber</td><td></td><td>Absorber</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>1. Liner Material</td><td>5% coverage of each material and thickness for one Unit/Absorber</td><td>1. Absorber Spray/Oxidation nozzles</td><td>10% of each type and size</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>2. Absorber Spray/Oxidation nozzles</td><td>10% of each type and size</td><td>2. Absorber Mist Eliminator Washing Nozzles</td><td>10% of each type and size</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>3. Absorber Mist Eliminator Washing Nozzles</td><td>10% of each type and size</td><td>3. Absorber Mist Eliminator</td><td>5% of each type and size/configuration</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>4. Absorber Mist Eliminator</td><td>5% of each type and size/configuration</td><td></td><td></td></tr>
<tr><td>182.</td><td>VI/B</td><td>I-M1</td><td>25 of 51</td><td>7.03.01</td><td colspan="2">Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by the unit operating at Design point with an additional 10% margin. The outlet water content in the gypsum</td><td colspan="2">Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by all the unit operating at Design point with an additional 10% margin. The outlet water content in the</td></tr>
</table>

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| | | | | | shall be as per the requirement of the vacuum belt filters. | gypsum shall be as per the requirement of the vacuum belt filters. |
| 183. | SECTION -VI/ Part-A | III-A2 | 3 of 4 | 3.00.00(i) | Complete compressed air and piping network for service air and instrument air application in FGD and ZLD system (if provided). | Complete compressed air and piping network for service air and instrument air application in FGD and ZLD system (if provided). **Separate piping network for Service Air and Instrument Air shall be provided.** |
| 184. | SECTION -VI/ Part-A | VII MANDATORY SPARES | 12 of 61 | 1.19.00 | MANDATORY SPARES<br>Air Conditioning And Ventilation System | The referred clause stands deleted. |
| 185. | SECTION -VI/ Part-A | III-A3 Fire Fighting System | 1 of 2 | 1.2 | HVW Spray System:<br><br>Automatic fire detection cum high velocity water spray system shall be provided for various transformers (having oil capacity 2000 liters or more) envisaged under this | HVW Spray System:<br><br>Automatic fire detection cum high velocity water spray system shall be provided for various transformers (having oil capacity 2000 liters or more) envisaged under this |

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| | | | | | package. Tapping for HVW spray system shall be provided from nearby existing **hydrant** header. | package. Tapping for HVW spray system shall be provided from nearby existing **Spray** header. |
| 186. | SECTION -VI/ Part-A | III-A3 Fire Fighting System | 1 of 2 | 1.00.00 (1.4) | Five numbers each type of Portable fire extinguishers consisting of water type, dry chemical powder type, C02 type shall be provided in various facilities of FGD system. | The contractor shall supply the following quantity (minimum) of fire extinguishers and install the same at various locations of FGD system as per TAC requirement.<br>1. Pressurized water type (9lit. capacity as per IS 15683): 5 nos<br>2. Co2 type (4.5 kg Cap IS:15683): 5 nos<br>3. Dry chemical type (6 kg Cap IS:15683) : 5 nos |
| 187. | SECTION -VI/ Part-B | I-M3 COMPRESSED AIR SYSTEM | 1 OF 7 | 1.01.00 | The compressed air system shall consist of Air compressors & their motor drives, Air Drying (ADPs) Plants, air receivers for each Air compressors, instrumentation and control, control panels, compressed air piping, Instrument Air Piping | The compressed air system shall consist of Air compressors & their motor drives, Air Drying (ADPs) Plants, air receivers for each Air compressors, instrumentation and control, control panels, compressed air piping, Instrument Air Piping |

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| | | | | | network, service air piping network and **Unit Instrument Air receivers (One for each unit)** | network, service air piping network etc. |
| 188. | SECTION -VI/ Part-B | I-M3 COMPRESSED AIR SYSTEM | 2 of 7 | 3.01.00 | Air Compressors (screw /Centrifugal type) shall be designed for continuous operation with high efficiency to satisfy the performance requirement as specified in the Data Specification Sheet. | Air Compressors (screw type) shall be designed for continuous operation with high efficiency to satisfy the performance requirement as per approved data sheet submitted by the bidder during detailed engineering |
| 189. | SECTION -VI/ Part-B | I-M3 COMPRESSED AIR SYSTEM | 2 of 7 | 3.04.00 | Compressor frame shall have min. 10% extra capacity. Compressor shall have 25% min. turndown capacity. Compressor shall be provided with IGV at the suction flange. | The clause stands deleted. |
| 190. | SECTION -VI/ Part-B | I-M4 Fire Detection & Protection Syste | 1 of 18 | 3.01.00 | HVW AND MVW SPRAY SYSTEM<br><br>General<br>It shall consists of **Spray Pumps, Pressurization arrangements**, water mains network, deluge valves, **alarm valves, flow switches,** | HVW AND MVW SPRAY SYSTEM<br><br>General<br>It shall consists of water mains network, deluge valves, isolation valves, Y type strainers, spray nozzles/ projectors, spray nozzles |

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| | | m | | | isolation valves, Y type strainers, spray nozzles/ projectors, spray nozzles piping network, detection system, instrumentation, local control panels, cables etc.. | piping network, detection system, instrumentation, local control panels, cables etc. |
| 191. | SECTION -VI/ Part-B | I-M2 Air Conditioning and Ventilation | 1 of 26 | 3.01.00 | Unitary Air Filtration (UAF) units of min. capacity 75,000 m3/hr. or capacity calculated considering 8 air changes per hour whichever is higher, shall be provided for Non-Air Conditioned areas of FGD and ZLD (as provided) control building (e.g. Switch gear rooms, cable galleries, etc.) | Modular type UAF units of suitable capacity (1x100%) shall be provided for non-air conditioned area of FGD control room /FGD cum ZLD control room building considering design philosophy for evaporative type ventilation system mentioned in clause 7.03.00, sub section- V (salient design data and sizing), Part-A of technical specification section VI. All non-air conditioned area of FGD (cable gallery& MCC room shall be positively ventilated and exhaust shall be through gravity damper. |
| 192. | VI/ A | VI | 22 of 24 | 5.00.00( xxii) | Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)<br>((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs | Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)<br>((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs |

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| | | | | | and at 30 deg C for centrifugal fans of **air washer units and at an elevation of RL (+) - m for both AHUs and Air washer unit centrifugal fans.)** | and at 30 deg C for centrifugal fans of **UAF and at an elevation of RL (referring to GLP of respective projects) for both AHUs and UAF centrifugal fans.)** |
| 193. | VI/B | I-M4 | Page 2 of 18 | 5.02.00 (iii) | Above and Below false ceiling areas of all air-conditioned rooms of FGD and ZLD (as provided) control room building, various control rooms of auxiliaries as defined in Sl. No. (i) above **and return air ducts of inert gas protected areas.** | Above and Below false ceiling areas of all air-conditioned rooms of FGD and ZLD (as provided) control room building, various control rooms of auxiliaries as defined in Sl. No. (i) above. |
| 194. | VI/ | I-M2 | Page 2 of 26 | 3.02.00 (iii) | Battery rooms & Oil rooms and fumes/odor generates ; Combination of Supply air fan & Exhaust air fans. Motors shall be flame proof. | Battery rooms & Oil rooms and fumes/odor generates ; Combination of intake louvers & Exhaust air/ roof extractor fans. Motors shall be flame proof. |

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<tr><th>SEC/ PART</th><th>SUB SEC.</th><th>PAGE NO.</th><th>CLAUSE NO.</th></tr>
<tr><td>195.</td><td>VI/A</td><td>II-A10</td><td>30 of 30</td><td>List of Drawings</td><td>---</td><td>Pipe cable trestle layout:<br>(a) To (c) 9558-360-POC-C-307-sh1,2,3.<br>(d) 9558-102-PVM-W-0023<br>Pipe cable trestle foundation:<br>(a) 9558-360-POC-C-312<br>(b) 9558-102-PVC-V-029A<br><br>Refer Annexures- A(i) to A(vi)</td></tr>
<tr><td>196.</td><td>VI/A</td><td>II-A11</td><td>29 of 29</td><td>List of Drawings</td><td>Table-6<br><table><tr><td>5.</td><td>Pipe Cable Trestle Layout</td><td>Not located near FGD area</td></tr><tr><td>6.</td><td>Pipe Cable Trestle Foundation</td><td>Not located near FGD area</td></tr></table></td><td>Table-6<br><table><tr><td>5.</td><td>Pipe Cable Trestle Layout</td><td>0270-315-POC-C-589-SH3</td></tr><tr><td>6.</td><td>Pipe Cable Trestle Foundation</td><td>0270-315-POC-C-589-SH1</td></tr></table><br>Refer Annexures- B(i) to B(ii)</td></tr>
</table>

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| 197. | VI/P ART-A | II-A1<br>II-A2<br>II-A3<br>II-A4<br>II-A-5<br>II-A6<br>II-A7<br>II-A8<br>II-A9<br>II-A10<br>II-A11 | - | - | **General Layout Plan**<br>1. Kudgi (3x800 MW)<br>9573-999-POC-F-001 Rev.6D1<br>2. Lara (2x800 MW)<br>9548-999-POM-F-001 Rev.6D0<br>3. Gadarwara (2x800 MW)<br>9572-999-POC-F-001 Rev.5D1<br>4. Darlipali (2x800 MW)<br>9549-999-POC-F-001 Rev.09<br>5. Mouda (2x660 MW)<br>9561/9575-999-POC-F-001 Rev.11-D0<br>6. Solapur (2x660 MW)<br>9571-999-POC-F-001 Rev.5D0<br>7. Tanda (2x660 MW)<br>9562-999-POC-F-002 Rev.8D1<br>8. Nabinagar JV (3x660 MW)<br>0370-999-POC-F-001 Rev.9 | **General Layout Plan**<br>1. Kudgi (3x800 MW)<br>9573-999-POC-F-001 Rev.7<br>2. Lara (2x800 MW)<br>9548-999-POM-F-001 Rev.8<br>3. Gadarwara (2x800 MW)<br>9572-999-POC-F-001 Rev.6<br>4. Darlipali (2x800 MW)<br>9549-999-POC-F-001 Rev.10<br>5. Mouda (2x660 MW)<br>9561/9575-999-POC-F-001 Rev.11<br>6. Solapur (2x660 MW)<br>9571-999-POC-F-001 Rev.5<br>7. Tanda (2x660 MW)<br>9562-999-POC-F-002 Rev.9<br>8. Nabinagar JV (3x660 MW)<br>0370-999-POC-F-001 Rev.10<br>9. Meja (2x660 MW) |

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| | | | | | 9. Meja (2x660 MW)<br>0360/0361-999-POC-F-001 Rev.6D0<br>10. Barh (3x660 MW)<br>9558/9560-999-POC-F-001 Rev.8D0<br>11. Nabinagar (4x250MW)<br>0270-999-POC-F-001 Rev. 6 | 0360/0361-999-POC-F-001 Rev.7.<br>10. Barh (3x660 MW)<br>9558/9560-999-POC-F-001 Rev.8<br>11. Nabinagar (4x250MW)<br>0270-999-POC-F-001 Rev. 8 |

# AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

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| 1. | SECTION – VI, PART-B | SUB-SECTION-III-C2 MEASURING INSTRUMENTS | 19 to 30 of 34 | 10.00.00, 10.01.00, 10.02.00, 10.03.00, 10.04.00, 11.00.00, 11.01.00, 11.02.00, 11.03.00, 11.04.00, 11.05.00, 11.06.00, 11.07.00, 11.08.00 | Clauses 10.00.00 to 10.04.00 and clauses 11.00.00 to 11.08.00 | Clauses 10.00.00 to 10.04.00 and clauses 11.00.00 to 11.08.00 replaced as per attached **C&I Annexure-I** |
| 2. | SECTION – VI, PART-A | SUB-SECTION-VII, Mandatory Spares | 44 of 61 | Main clause 1.25.00 | Clause no. 1.01.01, 1.01.02, 1.01.03, 1.01.04, 1.02.00, 1.03.00A, 2.07.00 | Clause no. 1.01.01, 1.01.02, 1.01.03, 1.01.04, 1.02.00, 1.03.00A, 2.07.00 (Main clause 1.25.00 CONTROL AND INSTRUMENTATION) replaced as per attached **C&I Annexure-II.** |
| 3. | SECTION – VI, PART-A | SUB-SECTION-VII, Mandatory Spares | 44 of 61 | Main clause 1.25.00 | --- | New Clause no. 1.01.05 added in mandatory spare main clause 1.25.00 as per attached C&I **Annexure-II.** |

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| | | | | | | |
| 4. | SECTION – VI, PART-A | SUB-SECTION-VII, Mandatory Spares | 55 of 61 | Main clause 1.26.00 ELECTRICAL | Mandatory spare Clause no. 1.02.00 ELECTRICAL ACTUATOR | Mandatory spare Clause no. 1.02.00 ELECTRICAL ACTUATOR (Main clause 1.26.00 ELECTRICAL) replaced as per attached C&I **Annexure-II.** |
| 5. | SECTION – VI, PART-B | SUB-SECTION-II-E8 ELECTRIC ACTUATOR WITH INTEGRAL STARTERS | 1 to 5 of 5 | | SUB SECTION-II-E8 ELECTRIC ACTUATOR WITH INTEGRAL STARTERS | CHAPTER DELETED |
| 6. | SECTION – VI, | SUB-SECTION-IIIC-8 | 1 to 4 of 4 | | SUB-SECTION-IIIC-8 ELECTRIC ACTUATORS | NEW CHAPTER ADDED as per attached C&I **Annexure-III**. |

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| | PART-B | ELECTRIC ACTUATORS | | | | |
| 7. | SECTION – VI, PART-B | SUB-SECTION-III-C2 MEASURING INSTRUMENTS | 2 of 34 | 2.01.00 | 2.01.00 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS | Clauses 2.01.00 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS updated as per attached C&I **Annexure-IV.** |
| 8. | SECTION – VI, PART-B | SUB-SECTION-III-C2 MEASURING INSTRUMENTS | 10 of 34 | 3.05.00 | 3.05.00 TEMPERATURE TRANSMITTER (TT) | 3.05.00 TEMPERATURE TRANSMITTER (TT) updated as per attached C&I **Annexure-IV.** |
| 9. | SECTION – VI, PART-B | SUB-SECTION-III-C2 MEASURING | 34 of 34 | New clause 15.00.00 | -- | New clause 15.00.00 Vibration Monitoring System (VMS) added as per attached C&I **Annexure-IV**. |

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| | | INSTRUMENTS | | | | |
| 10. | SECTION – VI, PART-B | SUB-SECTION-III-C2 MEASURING INSTRUMENTS | 34 of 34 | New clause 16.00.00 | -- | NEW clause 16.00.00 FIELD INSTRUMENTS BASED ON FIELDBUS added as per attached C&I **Annexure-IV**. |
| 11. | SECTION – VI, PART-B | SUB-SECTION-IIIC-9 CONTROL DESK & PANELS | 1 to 3 of 3 | | ---- | SUB-SECTION-IIIC-9 CONTROL DESK & PANELS<br>NEW CHAPTER ADDED as per attached C&I **Annexure-V**. |

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| 12. | SECTION – VI, PART-B | SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM | | | SUB-SECTION-III-C5<br>PLC BASED<br>CONTROL SYSTEM | CHAPTER replaced with SUB-SECTION-III-C5, DDCMIS as per attached C&I **Annexure-VI**. |
| 13. | SECTION – VI, PART-B | SUB-SECTION-IIIC-10 POWER SUPLY | | | --- | SUB-SECTION-IIIC-10 POWER SUPPLY<br>SEPARATE CHAPTER for POWER SUPPLY ADDED as per attached C&I **Annexure-VII**. |

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| 14. | SECTION – VI, PART-A | SUB-SECTION-III-B | 2 of 6 | 1.05.00 | Electric actuators with integral starters along with associated accessories etc shall be supplied on as required basis for Valves / Dampers to meet the functional and the other specification requirements. | DELETED. |
| 15. | SECTION – VI, PART-A | SUB-SECTION-III-C C&I | 1 to 9 | | Sub Section IIIC/Part-A. | Replacing existing IIIC/Part-A with attached C&I **Annexure-VIII.** |
| 16. | SECTION – VI, PART-E | Tender drawing C&I | 13 of 53 (of PDF) | | Standard configuration drawing for PLC based offsite control system. Tender drawing no. 0000-151-POI-A-013. | Standard configuration drawing for control system. Tender drawing no. 0000-151-POI-A-013 updated and attached as per C&I **Annexure-IX**. |
| 17. | SECTION – VI, PART-B | SUB-SECTION-I-M6, LIMESTONE HANDLING | 13 OF 73 | 4.9.6 | Specification of vibration monitoring system | DELETED |

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| | | PLANT (LHP) | | | | |
| 18. | SECTION – VI, PART-A | SUB-SECTION-III-A1, FGD | 7 OF 9 | 11.01.00 | ….Gypsum Dewatering system & FGD common control room & **analyser room (if required)**. The buildings must be complete……. | ….Gypsum Dewatering system & FGD common control room & containerised room (portable cabin) for analysers. The buildings must be complete……. |
| 19. | SECTION – VI, PART-B | SUB-SECTION-IIIC-11 Containerised cabin (Portable room) | | | | SUB-SECTION-IIIC-11 CONTAINERISED ROOM (PORTABLE CABIN)<br>SEPARATE CHAPTER ADDED as per attached C&I **Annexure-X**. |

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| 19(a) | SECTION – VI, PART-A | SUB-SECTION-VII, Mandatory Spares | 21 of 61 | 1.22.00 FIRE DETECTION AND PROTECTION SYSTEM | - | New Clause no. 7.5 and 7.6 added in mandatory spare main clause 1.22.00 as per attached C&I Annexure-II. |
| 19(b) | SECTION – VI, PART-A | SUB-SECTION-III-A2, | 1 of 4<br><br>2 of 4 | Clause 1.00.00 g)<br><br>Clause 2.00.00 g) | Contractor shall provide ……. control system is also acceptable.<br><br>Contractor shall provide ……. control system is also acceptable. | Control and monitoring of air conditioning and ventilation system shall be done from FGD control system.<br><br>Control and monitoring of air conditioning and ventilation system shall be done from FGD control system. |
| 19(c) | SECTION – VI, PART-B | SUB-SECTION-I-M2, AIR CONDITIONING AND VENTILATION | 19 of 26 | Clause 7.02.01 | Contractor shall provide ……. control system is also acceptable. | Control and monitoring of air conditioning and ventilation system shall be done from FGD control system. |
| 20. | VI/B | 11-E4 | 4 OF 6 | 2.14.04 | Cables shall be armoured type if laid in CHP area or directly buried | Cables shall be armoured type if laid in CHP area, directly buried and FGD Lime Stone and Gypsum Handling area |
| 21. | VI/B | II-E6 | 6 OF 69 | 3.05.01 | Termination……. (Tender drg. No 0000-211-POE–A-51-RA of cable lug attached at the end of this chapter.) | Termination….. (Tender drg. No 0000-211-POE–A-51-RA of cable lug attached at the end of this chapter.) Tender drawing attached as Electrical **Annexure E3**- 0000- |

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| | | | | | | 211-POE–A-51-RA. |
| 22. | VI/B | II-E15 | 10 OF 16 | 4.01.00.19 | In the Offsite area/buildings DC lighting shall be provided by self-contained 90 minutes duration Emergency lighting fixtures .Each shall be provided with Ni-Cd battery, battery charger & 2X10 W fluorescent lamps. | Deleted |
| 23. | VI/B | II E6 | 2 of 23 | 2.01.01 | Interplant cabling…….. All buried cables shall be armoured. | Interplant cabling ……Cables crossing Railway line (if applicable) shall be laid underground through nearest culvert. Necessary statutory clearance if required shall be taken by Bidder |
| 24. | VI/A | IIIB | 5 of 6 | 1.15.00 | ---NA--- | Size of ESP standby transformers to be fed from 11kV FGD switchgear are as follows:<br>Kudgi, Lara, Mauda-II, Solapur, Meja New nabinagar. Barh-I — 1.6MVA<br>Darlipali, Gadarwara, Tanda-II — 2 MVA<br>Nabinagar JV — 1.6MVA |
| 25. | VI/E | | 53 | | Electrical Single Line Diagram for FGD Package 0011-109-POE-J-001 rev B | Electrical Single Line Diagram for FGD Package 0011-109-POE-J-001 rev C Attached as Electrical **Annexure E4**- 0011-109-POE-J-001 rev C. |
| 26. | VI/B | II-E1 | 3 of 7 | 2.01.01 | Adequate number of auxiliary transformers shall be provided to meet the demand on 11KV, 3.3KV and 415V systems under most onerous conditions, with the criteria that each 3.3KV / 415 | Adequate number of auxiliary transformers shall be provided to meet the demand on 11KV, 3.3KV and 415V systems under most onerous conditions, with the criteria that |

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| | | | | | V switchgear / MCC / DB shall be fed by 2x100% or 3 X 50 %, 3x100% transformers / feeders, and these shall be rated to carry the maximum load expected to be imposed. | each 3.3KV / 415 V switchgear / MCC / DB shall be fed by 2x100% or 3 X 50 %, transformers / feeders, and these shall be rated to carry the maximum load expected to be imposed. **Wherever three incomer two bus coupler scheme is indicated, each incomer shall be sized to cater to load on its own bus section plus load on adjacent bus section.** |
| 27. | VI/B | II-E12 | 1.01.00 (s) | 4 of 31 | TECHNICAL PARAMETERS<br>(s) Termination Details (Indicative only)<br>(3) LV Phase Terminal 3.45kV- Busduct (Non-Segregated) | TECHNICAL PARAMETERS<br>(s) Termination Details (Indicative only)<br>(3) LV Phase Terminal 3.45kV- Busduct |
| 28. | VI/B | II-E12 | 1.01.00 (n) 5 Method of neutral earthing and Vector group | 2 of 31 | REPLACE EXISTING TABLE. | ATTACHED TABLES—**Electrical Annexure E1** |
| 29. | VI/B | II-E12 | 1.01.00 (p) | 3 of 31 | REPLACE EXISTING TABLE. | ATTACHED TABLES— **Electrical Annexure E1** |

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| 30. | VI/B | II-E12 | 1.01.00 (r) | 4 of 31 | REPLACE EXISTING TABLE. | ATTACHED TABLES— **Electrical Annexure E1** |
| 31. | VI/B | II-E12 | 1.01.00 (t) | 5 of 31 | REPLACE EXISTING TABLE. | ATTACHED TABLES— **Electrical Annexure E1** |
| 32. | VI/B | II-E18 | --- | --- | ------- | VARIABLE FREQUENCY DRIVE (VFD) chapter added as **Electrical Annexure E2** |
| 33. | VI/A | III-B | 1.15.00 | 5 of 6 | **------** | Variable Frequency Drive (VFD)<br><br>The VFD system shall be provided for the equipment drive motors as envisaged in relevant portions of the specifications for equipment. The system shall be either Voltage Source Inverter (VSI) or Current Source Inverter (CSI) type. Complete VFD system along with associated equipment, HT/LT panel, HT/LT cable, Transformer etc. as applicable shall be provided. Bidder to provide Air-conditioned room to house Variable Frequency Drive (VFD). |
| 34. | VI/B | II-E1 | 4 of 7 | 2.05.00 (c) | | **In case of any augmentation in owners HT switchgear (for ID booster fan motors), bidder shall make necessary provisions for switchgear control from owners DDCMIS/FGD DDDCMIS/FGD PLC (as decided during detailed engineering).** |

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| | | | | | | **Necessary control wiring for this purpose shall be in bidder's scope.** |
| 34(a) | VI/B | II-E2 | 2 of 9 | 3.01.00 b) | Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30 | Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. **HT motors shall have minimum design efficiency of 95 % Tolerance on efficiency value applicable as per IEC 60034** |
| 34(b) | VI/A | D-01 | 1 OF 282 | 5.03.09, PARA 7, LINE 3 | The type of aviation obstruction lighting system shall be of medium intensity aviation obstruction lights having an effective intensity of 2000 to 20,000 cd depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 20000 cd. The intensity of lights shall be 20000 cd ± 25% at twilight and shall reduce automatically to a night time intensity of 2000 cd ± 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the | The type of aviation obstruction lighting system shall be of high intensity aviation obstruction lights having an effective intensity of **4000** to 200,000 cd (minimum) depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 200000 cd. The intensity of lights shall be 20000 cd ± 25% at twilight and shall reduce automatically to a night time intensity of **4000 cd** ± 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction lights and there will be four light units per level. The |

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| | | | | | intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc. | lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc. |
| 35. | Section VI / Part B | Sub-Section -IV-D Civil Works | 2.00.00 | 1 of 69 | "Sub QR for civil works:" | **" Clause Deleted"** |
| 36. | VI/B | Sub-section IVD Civil Works | 1.02.00 | 01 of 69 | The specifications are intended for the general description of the work.....in writing with the Employer in respect of interpretation of any portions of this document. | The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. **Where provisions are not covered in Indian Standards, reference shall be made to ACI, AISC, ASCE, EN, CICIND and other international standards or to the best prevailing local Public Works Department practices or to the instructions of the Engineer.** Some of the relevant I. S. Codes to be followed |

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| | | | | | | are mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document. |
| 37. | VI/A | II-A1/A3/A4/A5/A6/A7/A9/A11 Project Information | 5.00.00 | | SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT | **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"** given in **"Civil Annexure-1"** to this amendment shall replace the **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"** at **Clause 5.00.00, Sub-section-II- A1/ A3/A4/A5/A6/A7/A9/A11, Part-A, Sec-VI, of Tech. Specification.** |
| 38. | Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T)) Sl.No. 13, Page-8 of 102 | | | | "SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT" of Lara STPP Project | **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"** of Lara STPP Project given in **"Civil Annexure-2"** to this amendment shall replace the **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"** Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T)), Sl.No. 13, Page-8 of 102 |

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| 39. | Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T))<br>Sl.No. 14, Page-8 of 102 | | | | "SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT" of Barh STPP Project | **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"**<br>of Barh STPP Project given in **"Civil Annexure-3"** to this amendment shall replace the **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"** at Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T)), Sl.No. 14, Page-8 of 102 |
| 40. | Errata No.01 to Technical specifications, Section-VI (Doc. No.:CS-0011-109(1A)-2-ERRATA-01) | | | | "SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT" of Nabinagar STPP Project (3x660MW) | **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"**<br>of Nabinagar STPP (3x660MW) Project given in **"Civil Annexure-4"** to this amendment shall replace the **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"** at Errata No.01 to Technical specification (Doc. No.:CS-0011-109(1A)-2-ERRATA-01). |

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| 41. | Section VI / Part B | Sub-Section-IV-D Civil Works | 17.01.00 | 35 of 69 | Design of steel structures shall be done by working stress method. Design shall be as per provisions of IS:800:1984. | Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards. |
| 42. | Section VI / Part B | Sub-Section-IV-D Civil Works | 17.26.00 | 38 of 69 | - | For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015 for Earthquake loads. |
| 43. | Section VI / Part B | Sub-Section-IV-D Civil Works | 17.27.00 | 38 of 69 | - | Design drawings of steel structures shall include the connection, joint & fastener details for Main columns, Beams & Bracings. |
| 44. | VI/A | IIA2 | BORE LOG | Page:23 to 39 of 48 | BH No.53,54,55,57,58,60,163,164 | **"Bore Logs"** given in **"Civil Annexure-5"** to this amendment shall replace the contents of **Bore Logs, Page 23 to 39 of 48,** Sub-section- II-A2, Part-A Sec-VI, of Tech. Specification. |
| 45. | VI/B | IV-D | 3.01.00(a) | 4 of 69 | -------- | **New Clause:**<br>**Limestone Storage Silo**<br>The supporting structure for silo shall be of structural steel. Independent supporting structure shall be provided for each silo. |
| 46. | Amendment No. 03 to technical specification (Section-VI)<br>Sl. No. 02, Page 2 of 102 | | | | Single-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for | Single-flue chimney(s) shall be provided, **except for Tanda TPP (2X660MW) and Meja TPP (2X660MW) where twin-flue** |

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| | | | | | each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level. **The centre to centre distance between the proposed chimney(s) and the existing chimney(s) in any direction shall not be less than 150 metres.** | **Chimney shall be provided.** Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. **The flue gas emission point for single flue chimney** shall be minimum 150 meters above the plant grade level **and for twin flue chimney flue gas emission point shall be minimum 220m above the plant grade level.**<br>The centre to centre distance between the proposed chimney(s) and the existing chimney(s) in any direction shall not be less than 150 metres.<br><br>**For Barh-I (3X660MW) already existing 275m high chimneys shall be utilized with modifications as specified elsewhere in mechanical specification and hence, new chimney is not to be provided under FGD package**. **General Arrangement Drawing of already existing Chimneys at Barh-I are provided in Sub Section-II -A10, Part A, Section-VI for reference.** |
| 47. | VI/B | IV-D | 3.14.01 Para 3 | 11 of 69 | The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct **shall be bottom supported and** shall be profiled into a circular shape to connect to the | The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be profiled into a circular shape to connect to the flue liner. The flue |

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| | | | | | flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic **fluroelastomeric fabric** expansion joint. | duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic expansion joint. |
| 48. | VI/B | IV-D | 3.14.01 Para 4 | 11 of 69 | The expansion joint in the flue liner shall comprise of non-metallic **fluoroelastomeric** material suitable **to withstand a temperature of 300 Deg C**, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable **to withstand a temperature of 300 Deg C** and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh. | The expansion joint in the flue liner shall comprise of non-metallic material suitable **for wet stack operations,** shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable **for wet stack operations** and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh. Design of expansion joint shall comply EPRI guideline to avoid contact of condensate with expansion joint material and to ensure drainage of condensate. |
| 49. | VI/B | IV-D | 3.14.01 Para 5 | 11 of 69 | Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell | Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from |

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| | | | | | with chequered plate floor panels and pipe handrails, shall be provided **for full height of the chimney** and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch. | chimney shell with chequered plate floor panels and pipe handrails, shall be provided **upto the platform just below roof platform** and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch. |
| 50. | VI/B | IV-D | 3.14.01 Para 6 | 11 of 69 | The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, **mild steel wind strakes (if required),** all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects. | The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but |

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| | | | | | | reasonably implied and necessary to complete the job in all respects. |
| 51. | VI/B | IV-D | 3.14.02 Para 7 | 12 of 69 | The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. **Design of all chimney components shall be based on working stress method.** | The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. |
| 52. | VI/B | IV-D | 3.14.03 Para 1 | 12 of 69 | The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The **load calculation and load combinations** shall be as detailed in IS 4998 **(Part 1) : 1992**. The wind shield shall be analysed for cases with and without flue liner loads. | The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The **analysis and design of wind shield shall be carried out as per IS 4998**. The wind shield shall be analysed for cases with and without flue liner loads. |
| 53. | VI/B | IV-D | 3.14.03 Para 2 | 12 of 69 | Forces/stresses in the wind shield due to eccentricity effects of local **(e.g. corbel)** loadings, insolations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered. | Forces/stresses in the wind shield due to eccentricity effects of local loadings, insolations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered. |
| 54. | VI/B | IV-D | 3.14.03 Para 6 | 12 of 69 | The stresses for the shell design shall not exceed the limits given in Cl. 7.0 of IS:4998 (PART-I) 1975 for various combinations of loads, excepting the stress in concrete for the case of dead load + wind load which shall not | DELETED |

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| | | | | | exceed 0.30fck where fck is the characteristic compressive strength of concrete. | |
| 55. | VI/B | IV-D | 3.14.03 Para 9 | 13 of 69 | There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a **sudden** change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level. | There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level. |
| 56. | VI/B | IV-D | 3.14.03 Para 14 | 13 of 69 | The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located in the area or in the future expansion stage of the project shall be determined along with the other topographical features of the local area through model test. | The final design shall be checked & verified by 'Wind Tunnel Test' conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located **upto distance of 20 times diameter at 2/3$^{rd}$ height of subject chimney,** in the area or in the future expansion stage of the project**, as envisaged by the owner at the time testing,** shall be determined along with the other topographical features of the local area through model test. |
| 57. | VI/B | IV-D | 3.14.04 Para 5 | 13 of 69 | Clean-out door shall be provided below the flue for the removal of ash. | DELETED |

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| 58. | VI/B | IV-D | 3.14.07 Para 5 | 14 of 69 | The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation for any loading condition. Since chimney is a wind sensitive structure no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. **No allowance shall be made in the stresses for design of foundation for wind loading.** The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum **M 25**. | The chimney foundation shall be designed **as per limit state method as per IS 4998** for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation/**piles** for any loading condition. Since chimney is a wind sensitive structure, no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum **M 30**. |
| 59. | VI/B | IV-D | 3.14.08 Para 2 | 14 of 69 | The insulation thickness shall be determined based on the maximum/minimum ambient | DELETED |

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| | | | | | temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 55 degree Celsius. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness. | |
| 60. | VI/B | IV-D | 3.14.09 (i) | 15 of 69 | All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) **except surfaces of steel wind strakes** shall be painted as specified in corrosion protection clause of this specification. | All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) shall be painted as specified in corrosion protection clause of this specification. |
| 61. | VI/B | IV-D | 3.14.09 (ii) | 15 of 69 | All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT.<br>a) All steel surfaces shall be provided with two component epoxy primer coat (having solid by volume minimum 51% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer | DELETED |

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| | | | | | coat shall be applied in shop immediately after blast cleaning by airless spray technique.<br>b) Primer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.<br>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 $\Delta E$) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. | |
| 62. | VI/B | IV-D | 3.14.09 (iii) | 15 of 69 | All steel parts embedded in concrete like **Strake embedment assembly including** bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes. | All steel parts embedded in concrete like bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes. |

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| 63. | VI/PART-A | II-A1<br>II-A2<br>II-A3<br>II-A4<br>II-A-5<br>II-A6<br>II-A7<br>II-A8<br>II-A9<br>II-A10<br>II-A11 | - | - | **General Layout Plan**<br>1. Kudgi (3x800 MW)<br>9573-999-POC-F-001 **Rev.7**<br>2. Lara (2x800 MW)<br>9548-999-POM-F-001 **Rev.8**<br>3. Gadarwara (2x800 MW)<br>9572-999-POC-F-001 **Rev.6**<br>4. Darlipali (2x800 MW)<br>9549-999-POC-F-001 **Rev.10**<br>5. Mouda (2x660 MW)<br>9561/9575-999-POC-F-001 **Rev.11**<br>6. Solapur (2x660 MW)<br>9571-999-POC-F-001 **Rev.5**<br>7. Tanda (2x660 MW)<br>9562-999-POC-F-002 **Rev.9**<br>8. Nabinagar JV (3x660 MW)<br>0370-999-POC-F-001 **Rev.10** | **General Layout Plan**<br>1. Kudgi (3x800 MW)<br>9573-999-POC-F-001 **Rev.8 (Civil Annex 6)**<br>2. Lara (2x800 MW)<br>9548-999-POM-F-001 **Rev.9 (Civil Annex 7)**<br>3. Gadarwara (2x800 MW)<br>9572-999-POC-F-001 **Rev.7 (Civil Annex 8)**<br>4. Darlipali (2x800 MW)<br>9549-999-POC-F-001 **Rev.11 (Civil Annex 9)**<br>5. Mouda (2x660 MW)<br>9561/9575-999-POC-F-001 **Rev.12**<br>**(Civil Annex 10)**<br>6. Solapur (2x660 MW)<br>9571-999-POC-F-001 **Rev.6 (Civil Annex 11)**<br>7. Tanda (2x660 MW) |

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| | | | | | 9. Meja (2x660 MW)<br>0360/0361-999-POC-F-001 **Rev.7**<br>10. Barh (3x660 MW)<br>9558/9560-999-POC-F-001 **Rev.8**<br>11. Nabinagar (4x250MW)<br>0270-999-POC-F-001 **Rev. 8** | 9562-999-POC-F-002 **Rev.10 (Civil Annex 12)**<br>8. Nabinagar JV (3x660 MW)<br>0370-999-PO-F-001 **Rev.11 (Civil Annex 13)**<br>9. Meja (2x660 MW)<br>0360/0361-999-POC-F-001 **Rev.8 (Civil Annex 14)**<br>10. Barh (3x660 MW)<br>9558/9560-999-POC-F-001 **Rev.9 (Civil Annex 15)**<br>11. Nabinagar (4x250MW)<br>0270-999-POC-F-001 **Rev. 9 (Civil Annex 16)** |
| 64. | VI/A | II-A10 | List of Drawings | 30 of 30 | - | Include the following new drawings enclosed herewith this Amendment at Sl. No. 6 & 7 respectively.<br>6. General Arrangement of Twin flue Chimney for Units1&2 (2x660 MW) – Drg. No. 9558-317-POC-A-001**(Civil Annex 17)** |

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| | | | | | | 7. General Arrangement of Single flue Chimney for Unit3 (1x660 MW) – Drg. No. 9558-317-POC-A-002**(Civil Annex 18)** |
| 65. | | | | New Clause | | **Bidder shall utilize the area identified for FGD purpose. The area identified for FGD purpose in GLP shall be levelled and free from obstructions like sheds, trees etc. However, site clearance like removal of bushes, vegetation etc. is in Bidder's scope.** |
| 66. | | | | New Clause | | **Dismantling & Removal of asbestos sheet shall be done by owner. However, site clearance like removal of bushes, vegetation etc. is in Bidder's scope.** |
| 67. | SECTION-VI/ Part-A | V SALIENT DESIGN DATA | 7.03.00 | 13 of 26 | DESIGN PHILOSOPHY – Ventilation System …… …… **Note : Dry bulb temperature during summer = 45 Deg C.** | DESIGN PHILOSOPHY – Ventilation System …… …… **Note : Dry bulb temperature during summer season mentioned in clause 7.01.00 (Appendix-A) Sub- section V, Part-A shall be considered as Design Ambient Temperature for above.** |

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| 68. | SECTION-VI/ Part-A | V SALIENT DESIGN DATA | 7.01.00 | 12 of 26 | For areas, where A/C load is of the order of 25-60 TR, Direct Expansion (DX) type Condensing unit (with AHU) shall be provided depending on the availability of space/ layout etc. For areas, where A/C load is of the order of 15-25TR, ductable split/packaged A/C shall be provided. Smaller areas which are away from the D-X type Condensing unit /central chilling units which may require air conditioning upto 15 TR rating shall be served with Hi-wall Split/Cassette air conditioner units as per requirement. | For areas like FGD control room where load is more than 15TR ,Direct expansion (D-X) type condensing unit (with AHU) shall be provided. For other areas where air conditioning requirement is 5-15 ductable split/packaged A/C shall be provided. If the air conditioning load is less than 5TR, then Hi-wall Split/Cassette air conditioner shall be provided. |
| 69. | SECTION-VI/ Part-A | III-A2 | 3.00.00(i) | 3 of 4 | Complete compressed air and piping network for service air and instrument air application in FGD and ZLD system (if provided). | Complete compressed air and piping network for service air and instrument air application in FGD and ZLD system (if provided) shall be as per Tender drawing of compressed air system. **(Mech Annexure I)** |
| 70. | VI/B | I-M4 | 5.02.00(b) | Page 2 of 18 | **Linear heat sensing cable detection system** Gypsum and lime conveyor of FGD system and Cable Galleries covered under MVW Spray System. | **Linear heat sensing cable detection system** Gypsum and lime conveyor of FGD system and Cable Galleries. |
| 71. | VI/B | I-M4 | 5.02.00(c) | Page 2 of 18 | **Quartzoid bulb heat detection system** Equipments protected by HVW spray system, conveyors protected by MVW spray system. | **Quartzoid bulb heat detection system** Equipments protected by HVW spray system. |

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| 72. | SECTION-VI/ Part-E | Tender Drawing List | 1.00.00 (A) | 1 of 2 | -- | Schematic drawing of compressed air system |
| 73. | VI/B | I-M4 Fire Detection & Protection System | 5.15.00Notes: (3) | Page 13 of 18 | Over and above, contractor may note that short term fire proof cables shall be provided for coal handling plant and inert gas protected areas. Short term fire proof cables shall be Mineral insulated copper conductor and copper sheathed type satisfying requirements of Fire resistance, safety in the industrial application areas mentioned in the specification and also, shall be approved by UL standards and certified by LPCB. The contractor shall provide all the cables so as to complete the system. | Over and above, contractor shall provide all the cables so as to complete the system. |
| 74. | VI/A | III-A2 | 2.00.00 (C) | 2 of 4 | **Miscellaneous areas:** All other areas like Limestone Grinding system building, Gypsum dewatering building, Recirculation pump & Oxidation Blower/compressor building etc & all other non-air conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers. For ventilation of Battery rooms and Oil rooms, fans with flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans. | **Miscellaneous areas:** All other areas like Limestone Grinding system building, Gypsum dewatering building etc & all other non-air conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers. For ventilation of Battery rooms and Oil rooms, fans with flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans.<br><br>**Note: The above list of Buildings is indicative only. Any Building under this** |

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| | | | | | | **package which are of enclosed type, shall be provided by Mechanical ventilation.** |
| 75. | VI/B | I-M4 | 5.05.00 | 5 of 18 | The detection zone/loop divisions of LHSC system shall match with MVW spray zones. Conveyors where LHSC shall be installed shall be divided into no. of various zones whereas conveyor for which IR detector is installed shall be considered as one zone. | The clause stands deleted |
| 76. | VI/B | I-M4 | 5.16.00 | 13 of 18 | Upon detection of fire either by QB detector or LHSC detector, the spray system shall be initiated. It shall also initiate spray system for the two adjacent zones after a time delay settable at site. | The clause stands deleted |
| 77. | VI/B | I-M4 | 5.05.00 | 5 of 18 | Mounting arrangement have been indicated in tender drawing. | Mounting arrangement will be provided as per proven practice. |
| 78. | SECTION-VI/ Part-A | III-A2 | 3.00.00(g) | 3 of 4 | Monorail with Chain pulley block of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more. | Monorail with electric hoist of minimum 2 tons or 125% of heaviest parts of equipment to be lifted whichever is more. |
| 79. | A | III-A6 Zero Liquid Discharge System | | | Chapter ‘Zero Liquid Discharge System’ | Chapter ‘deleted’. |

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| 80. | A | VI | 143 of 209 | 4.02.00 xvii) | Waste Water Treatment System (Applicable for Barh-I…….. …….. ……..filter test. | Deleted. |
| 81. | A | VII | 16-18 of 61 | 1.20.00 | SPARES FOR FGD Waste Water Treatment (FGD WWT) SYSTEM FOR ZLD(APPLICABLE FOR PROJECTS WHERE ZLD SYSTEM IS BEING PROVIDED) | Deleted. |
| 82. | B | I-M7 Zero Liquid Discharge System | | | Chapter 'Zero Liquid Discharge System' | Chapter 'deleted'. |
| 83. | E | | | | Process Flow diagram for FGD waste water treatment(FGDWWT) system for ZLD Drawing No. 0011-109-POM-A-005 (Sht. 1 of 3, Sht.2 of 3 & Sht. 3 of 3) | Deleted. |
| 84. | A | I Intent of Specification | 15 of 19 | 4.04.00, | FGD WASTE WATER REATMENT SYSTEM FOR ZERO LIQUID DISCHARGE (ZLD)…….. …….for each project. | Deleted |
| 85. | A | I Intent of Specification | 16 of 19 | 4.05.00 | Provenness criteria for critical equipment, auxiliaries, systems and bought out items for FGD waste…… ……/Anthracite coal/lignite. | Deleted |

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| 86. | A | I Intent of Specification | 3 of 19 | 1.03.05 | ZERO LIQUID DISCHARGE (ZLD) SYSTEM for FGD waste water for Barh-I…… | Deleted. |
| 87. | A | I Intent of Specification | 5 of 19 | 3.00.00 A(5) | Process Flow Diagram for FGD Waste water treatment (FGD WWT)….. | Deleted. |
| 88. | Attachmewnt-12 to Section VII | Part-F, Chapter-II, Sub Section :DM1 | 5 of 42 | 1.02.00 (xxviii) | Write up on ZLD… | Deleted |
| 89. | Attachmewnt-12 to Section VII | Part-F, Chapter-II, Sub Section :DM2 | | | Zero Liquid | Sub Section:DM2 ‘deleted’ |
| 90. | VI/A | III-A4 | 1 | 1.01.00(i) | Piping for normal ----------, piping for emergency ----------pump, other piping, fittings, supports, valves and specialties ----------and electrical equipment as required and as specified for the system. | Piping for normal ----------, piping for emergency ---------pump, other piping, fittings, supports, valves and specialties…....and **structural steel shed for housing various equipment of Equipment cooling water system alongwith necessary handling arrangement as per Cl No-14.09.00, Sub-section-M1, Part-B, Section-VI** and |

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| | | | | | | electrical equipment as required and as specified for the system. |
| 91. | VI/A | IV | 2 of 3 | 1.04.01 | Contractor shall take----------DM normal Make-up---------- available along C-row at CD bay rack---------- meeting the makeup water requirement of ECW system. The pressure available at TP will be 4Ksc wrt FGL (approx.). | Contractor shall take----------DM normal Make-up---------- available along C-row at CD bay rack---------- meeting the makeup water requirement of ECW system. The **quantity (maximum)** and pressure available at TP will be **2 m3/hr (Maximum)** and 4Ksc wrt FGL (approx.) respectively. |
| 92. | VI/A | IV | 2 of 3 | 1.04.02 | Contractor shall take----------DM emergency Make-up header ---------- available along C-row at CD bay rack---------- meeting the emergency makeup water requirement of ECW system. The pressure available at TP will be 4Ksc wrt FGL (approx.). | Contractor shall take----------DM emergency Make-up header ---------- available along C-row at CD bay rack---------- meeting the emergency makeup water requirement of ECW system. The **quantity (Maximum)** and pressure available at TP will be **2m3/hr** and 4Ksc wrt FGL (approx.) respectively. |
| 93. | VI/A | IV | 2 of 3 | 1.06.00 | For Gypsum washing, contractor shall take a tap off ----------rack for meeting the water requirement ----------washing. The pressure available at TP will be 4 Ksc (gauge) wrt FGL (approx.). | For Gypsum washing, contractor shall take a tap off ----------rack for meeting the water requirement ----------washing. The **water quantity** and pressure available at TP will be **0.015m3/hr/MW (Maximum)** & 4 Ksc (gauge) wrt FGL (approx.) respectively. |

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| 94. | VI/A | VII | 61 of 61 | 1.28.00 | ---------- | New Cl. 1.28.00 Added for mandatory spares of ECW system. Refer **Mechanical Annexure-II** |
| 95. | Section-VI, Part A | V | 2.01.01 | 2 of 6 | Limestone will be received to power plant either through road by trucks and through Indian railway rakes.<br><br>Lime stone received through Road shall be unloaded by Two (2) numbers Truck Tipplers each of minimum 40T capacity (Gross weight 60 T minimum) to discharge Limestone on to Box Feeders/ Surface Feeders/ Truck Unloading Hopper, complete with all mechanical, electrical and C&I, civil & structural works for unloading Limestone by truck tipplers.<br><br>Two (2) numbers Box Feeders/ Bulk-material Receiving Unit**/** ~~**Underground Truck Unloading Hopper /**~~ Surface feeder, for unloading of limestone from trucks/ self-tippling trucks/ loader shovels, complete with drives, accessories all mechanical, electrical and C&I, Civil & structural works, including its supporting foundations etc. This unit shall feed limestone onto the conveyor before Limestone crusher house. | Limestone will be received to power plant **through road by truck**.<br><br>Lime stone received through Road shall be unloaded by Two (2) numbers Truck Tipplers each of minimum 40T capacity (Gross weight 60 T minimum) to discharge Limestone on to Box Feeder/ Surface Feeder/ Truck Unloading Hopper, complete with all mechanical, electrical and C&I, civil & structural works for unloading Limestone by truck tipplers.<br><br>Two (2) numbers Box Feeders/Bulk-material Receiving Unit/Surface feeder, for unloading of limestone from trucks/self-tippling trucks/loader shovels, complete with drives, accessories all mechanical, electrical and C&I, Civil & structural works, including its supporting foundations etc. This unit shall feed limestone onto the conveyor before Limestone crusher house. |

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| | | | | | **Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house through series of new conveyors/bucket elevators. All necessary modifications involving Mechanical, Electrical, C&I, Civil and Structural works in the existing CHP for taking feed to new limestone path shall be in the scope of the bidder.** | |
| 96. | Section-VI, Part A | IV TERMINAL POINTS & EXCLUSIONS | 1.09.00 (i) | 2 of 3 | For unloading of Limestone through WT/Track Hopper of the existing Coal Handling Plant, limestone 'Feed Point' before existing CHP's Crusher House | **Clause DELETED.** |
| 97. | Section-VI, Part B | I-M6 LIMESTONE HANDLING PLANT | 3.1.0 | 2 of 73 | Unloading, Crushing and Bunker Feeding System<br>**Indian Railway rakes consisting of wagons consisting type of wagons as specified in RDSO G-33 (Rev-1) guidelines shall transport coal to the power plant. The coal received from wagons shall be unloaded in** | Unloading, Crushing and Bunker Feeding System<br>Two (2) numbers Box feeders/Bulk material receiving unit…….facilities.<br>A mechanized system……crusher. |

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| | | | | | **underground RCC hopper by means of side discharge type wagon tippler. Side discharge type wagon tipplers are to be employed for unloading IR Coal rake. Side arm chargers are envisaged for placement of wagon on the tippler table & removal of empty wagon from tippler table after tippling. Clear access shall be provided for movement of pay loader/bulldozers on the hopper grating of wagon tippler. Grating over wagon tippler hopper shall be placed and designed accordingly. Apron feeder along with dribble conveyor are employed under each wagon tippler for extracting coal from wagon tippler hoppers.**<br><br>**Indian Railway rakes consisting of Bottom discharge wagons shall also transport coal to the power plant. The coal received from wagons shall be unloaded in underground RCC Track hopper. Paddle feeders complete with all electrical, rails, supporting structures, end stops, cable reeling drums, trailing cables, and necessary arrangement for cabling on floor of track hoppers along with accessories, shall be installed at the bottom of the Track hoppers to scoop the coal from track hoppers and feed coal on to the underground conveyors.** | |

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| | | | | | **Limestone received through through railway rakes will be unloaded in one of these three side discharge wagon tipplers or track hopper.**<br><br>**Alternatively**, Two (2) numbers Box feeders/Bulk material receiving unit…….facilities.<br><br>A mechanized system……crusher. | |
| 98. | Section-VI, Part A | V | 10.15.00 | 25 of 26 | **Dust extraction system**<br><br>Type: **Venturi scrubber type**<br><br>Location: Truck un-loading points, Junction Towers (limestone/ gypsum discharge & receipt points), limestone crusher house (including belt feeder & vibrating screening feeder) and lime stone/gypsum storage Shed/Silo. | **Dust extraction system**<br><br>Type: **Bag Filter type**<br><br>Location: Truck un-loading points, Junction Towers (limestone/ gypsum discharge & receipt points), limestone crusher house (including belt feeder & vibrating screening feeder) and lime stone/gypsum storage Shed/Silo. |
| | | Sl. No. 73 Amdt no.3 to tech spec | | | | |
| 99. | Section-VI, Part A | VI | 4.02.00 | 15 of 19 | **Guarantees Under Category-II** | **Guarantees Under Category-II**<br>***New Clause for Guarantee for LHS & GHS added as under:***<br>**(xviii) Limestone Handling System and Gypsum Handling System.** |

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| | | | | | | The Bidder shall demonstrate the rated capacities of each conveying stream and the associated equipments for Limestone Handling system and Gypsum Handling System. |
| 100. | Section-VI, Part A | III-A5. | 2.01.11 & sl. No. 60 of Amdt no. 3 to Tech Spec. | 3 of 6 | One number of covered storage shed for crushed limestone. The storage shed shall be sufficient to store limestone equivalent to consumption of minimum 7 days at Design point (Generation of all units to be considered) **or 5000 MT (wherever Railway Rake unloading is envisaged) whichever is higher**. A reclaim hopper shall be provided below the limestone storage shed for the entire length of the stockpile. Alternatively, suitable number of Limestone Storage Silos to store limestone equivalent to consumption of minimum **7 days at Design point or 5000 MT (wherever Railway Rake unloading is envisaged) whichever is higher**. Suitable number of Belt feeders below silos shall be provided taking feed from silo and discharging onto onward conveyors/ Bucket elevators. | One number of covered storage shed**/silo** for crushed limestone. The storage shed shall be sufficient to store limestone equivalent to consumption of minimum 7 days at Design point (Generation of all units to be considered). A reclaim hopper shall be provided below the limestone storage shed for the entire length of the stockpile. Alternatively, suitable number of Limestone Storage Silos to store limestone equivalent to consumption of minimum **7 days at Design point**. Suitable number of Belt feeders **along with suitable crushed limestone feed regulating mechanism** below silos shall be provided taking feed from silo and discharging onto onward conveyors/ Bucket elevators.<br><br>**The Maximum capacity of each Limestone storage Silo shall not exceed 2000 MT.** |

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| 101. | Section-VI, Part A | III-A5 | 2.01.10 | 3 of 6 | Suitable number of motorized travelling tripper / flow diverter plough (as applicable) on each feeding conveyor for feeding the crushed limestone to the covered storage **shed**. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structure (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc. | Suitable number of motorized travelling tripper / flow diverter plough (as applicable) on each feeding conveyor for feeding the crushed limestone to the covered storage **shed/Silo**. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structure (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc. |
| 102. | Section-VI, Part B | I-M6 | 3.5.0 | 3 of 73 | **SYSTEM DESCRIPTION: GYPSUM HANDLING PLANT**<br><br>Double conveyor stream shall be provided for conveying dewatered gypsum from gypsum vacuum belt filter to over ground storage under a shed **near plant boundary**. The storage shed shall be sized for 7 days of gypsum production with all the units in operation. Gypsum from storage shed shall be loaded to user's trucks using front-end loader/ pay loader. | **SYSTEM DESCRIPTION: GYPSUM HANDLING PLANT**<br><br>Double conveyor stream shall be provided for conveying dewatered gypsum from gypsum vacuum belt filter to over ground storage **inside a closed storage shed preferably near plant boundary**. The storage shed shall be sized for 7 days of gypsum production with all the units in operation. Gypsum from storage shed shall be loaded to user's trucks using front end loader/ pay loader. |
| 103. | Section-VI, Part B | I-M6 | 4.11.3 (vii) | 16 of 73 | Feeder carriage drive shall be suitably designed so that the forward & reverse movement of carriage can be achieved without stopping the scooping operation. **Tank filled with water in DS system shall also be considered for travel** | Feeder carriage drive shall be suitably designed so that the forward & reverse movement of carriage can be achieved without stopping the scooping operation. |

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| | | | | | **drive. Capacity of tank mounted on tail end side shall be sufficient for half an hour operation.** | Dry type dust extraction system shall be provided. |
| 104. | Section-VI, Part B | I-M6 | 4.20.00 | 27 of 73 | --- | New Clause:<br>**Crushed Lime Stone Storage Silo:**<br>The crushed lime stone storage silo shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS 304 of minimum 4 mm thickness in the complete conical portion to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 (part 1 of 3) |
| 105. | Section-VI, Part A | III-A5 | 2.01.13 | 4 of 6 | Two (2) nos. of lime sampling units, one for as received limestone in crusher house and one for as used limestone in TP before feeding to limestone bunkers, complete with all accessories and electrical, civil, structural works, supporting structures, approach/maintenance platforms, hoists etc. | One (1) nos. of lime sampling unit, for as received limestone in crusher house complete with all accessories and electrical, civil, structural works, supporting structures, approach/ maintenance platforms, hoists etc. |
| 106. | **Sl. No.-178** AMENDMENT NO. CS-0011-109(1A)-2-AMDT-03(T) | | 107 of 117 | | The duct to Absorber inlet …….thickness. The duct from Absorber outlet to bypass duct shall be made of Carbon steel of minimum 7mm thickness cladded with 2 mm (minimum) thickness Alloy C276 / Alloy 59 or better material. | The duct to Absorber inlet …….thickness. The duct from Absorber outlet to the **new wet flue chimney** shall be made of Carbon steel of minimum 7mm thickness cladded with 2 mm (minimum) thickness Alloy C276 / Alloy 59 / **Titanium Gr-II**. |
| 107. | VI/B | I-M1 | 31 of 51 | 10.01.00 | **Slurry & Process Water Tanks:**<br><br>All the slurry tanks……..valves etc. | **Slurry & Process Water Tanks:** |

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| | | | | | Coarse- screen(s) at suction-side of these pumps shall be provided. | All the slurry tanks……..valves etc.<br>Coarse- screen(s) at suction-side of **slurry recirculation** pumps shall be provided. |
| 108. | VI/B | I-M1 | 34 of 51 | 13.03.07 | All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS: 803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell thickness as calculated by IS: 803, latest edition shall be provided by the Contractor. Tanks shall be made from IS: 2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replaceable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. | All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS: 803, latest edition. Additional Corrosion allowance of **1.5 mm** on the minimum tank shell thickness as calculated by IS: 803, latest edition shall be provided by the Contractor. Tanks shall be made from IS: 2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replaceable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake glass lining of minimum 3 mm thickness or **Epoxy lining minimum three coats of 150 micron thickness** and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. |
| 109. | VI/A | III-A1 | 7 of 9 | 11.01.00 | Contractor shall provide buildings for Limestone Grinding System; Slurry re-circulating pumps & | Contractor shall provide buildings for Limestone Grinding System, Compressors, |

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| | | | | | Oxidation blowers / Compressors; Gypsum Dewatering System & FGD control room & Analyser room (if required). The buildings must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipments of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc. | Gypsum Dewatering System & FGD control room. **Slurry re-circulating pumps & Oxidation blowers shall be located in a shed provided with roof sheeting.** The buildings/structure must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc. |
| 110. | VI/A | III-A1 | 4 of 9 | 4.01.11 | All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. *All pumps & Oxidation blowers shall be in straight line.* The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc. The building shall be sufficiently ventilated. | All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed in a **shed provided with roof sheeting** to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers shall be in straight line, **however, if it is not possible due to layout constraints, in such case, arrangement for handling & maintenance should be properly & optimally designed.** The **shed** must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc. |

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| 111. | VI/B | 10 of 51 | 4.02.00 (iv) | | Margin over pressure requirement:<br><br>44% over the calculated value | Margin over pressure requirement:<br><br>Bidder shall consider the margin over pressure requirement as 44% over the calculated head value excluding the static head. Margin on Static head shall be taken as 10%.For bubbling type Absorber, Bidder shall consider choking/blockage of 10% sparger tubes while calculating the head requirements of fan. |
| 112. | VI/B | I-M1 | 30 of 51 | 8.04.00 | All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized valves shall be …… shall be taken form the process water supply | All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized**/pneumatic** valves shall be …… shall be taken **from** the process water supply. **The process water lines shall be provided with pneumatic/motorized valves as per the proven practice of the Bidder.** |
| 113. | VI/A | III-A1 | 7 OF 9 | 7.08.00 | All the storage tanks shall be lined with vinyl ester based flake glass lining from inside. | All the storage tanks shall be lined with **replaceable chlorobutyl /bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake** |

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| | | | | | | **glass lining of minimum 3 mm thickness** from inside. |
| 114. | VI/B | I-M1 | 26 of 51 | 7.04.03 | The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design. | The complete frame of the filter and all parts in contact with gypsum shall be **made with corrosion resistant material.** |
| 115. | VI/B | I-M1 | 14 of 51 | 5.01.00(B) | **Bubbling Type Absorber**<br><br>(i) In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No recirculating pump and spray header and nozzles shall be required in such case. However, 2x 100% Cooling Pumps instead of Slurry Recirculation shall be provided. The spray headers & piping for cooling pump discharge shall be made of Alloy 59 or C276 and nozzles shall be made of Silicon Carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. The Cooling Pumps shall be installed inside a building.<br><br>The sparger ……. minimum life of 5 years.<br>Minimum 10% ……Sparger Tubes. | **Bubbling Type Absorber**<br><br>(i) In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No recirculating pump and spray header and nozzles shall be required in such case. However, **3 x 50% Gas** Cooling Pumps instead of Slurry Recirculation shall be provided. The spray headers & piping **which are in contact with hot flue gas** shall be made of Alloy 59 or C276 and nozzles shall be made of Silicon Carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. **Cooling Pump discharge piping and valves outside the flue gas path shall be in line with the requirements** |

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| | | | | | | **specified for slurry recirculation pumps. The Cooling Pumps shall be installed** in a **shed with roof sheeting.**<br><br>The sparger ……. minimum life of 5 years.<br><br>Minimum 10% ……Sparger Tubes. |
| 116. | VI/A | IV | 1 of 3 | 1.02.00 | **Flue Gas Duct**<br><br>(i)<br>Un cleaned Flue Gas<br>For each unit:<br><br>i) One tapping from the common Flue Gas Duct going towards the existing Chimney (in case of twin flue chimney). No load of duct shall be transmitted on the Employers facilities.<br><br>ii) One tapping …. on the Employers facilities. | **Flue Gas Duct**<br><br>(i)<br>Un cleaned Flue Gas<br>For each unit:<br><br>i) One**/two** tapping **(depending on layout feasibility owing to space limitations and subject to Employer's approval)** from the Flue Gas Duct going towards the existing Chimney. No load of duct shall be transmitted on the Employers facilities.<br><br>ii) One tapping …. on the Employers facilities. |

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| | | | | | | |
| 117. | VI/B | I-M1 | 2 OF 51 | 1.03.02 | The FGD system shall be … whenever the Steam Generator is in operation.<br><br>However, provision shall …….. the gas side, with the unit in operation. For this purpose. Motorized Guillotine type gates has be provided at (i) hot gas inlet to Booster Fans, (ii) Outlet of Booster Fans and (iii) in the bypass duct (common Flue Gas Duct going towards the existing Chimney). Further, Quick opening Bi-plane ….. designing the control & logics for the FGD System. | The FGD system shall be … whenever the Steam Generator is in operation.<br><br>However, provision shall …….. the gas side, with the unit in operation. For this purpose. Motorized Guillotine type gates has be provided at (i) hot gas inlet to Booster Fans, (ii) Outlet of Booster Fans. Further, Quick opening Bi-plane ….. designing the control & logics for the FGD System. |
| 118. | VI/B | I-M1 | 7 OF 51 | 3.03.01 | The arrangement of the flue gas system shall ……. at the outlet of each Booster fan. A gas tight, motor operated Guillotine gate shall be provided by the Contractor in the bypass duct (flue gas duct connecting the existing chimney). | The arrangement of the flue gas system shall ……. at the outlet of each Booster fan. |

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| 119. | **Sl.no. 177** AMENDMENT NO. CS-0011-109(1A)-2-AMDT-03(T) | | 106 of 117 | | A "wet Chimney" shall be ……without FGD system in operation. The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. The wet stack shall be designed as per the guidelines of EPRI Revised Wet Stack Design Guide.<br>Alternatively, …… year full replacement guarantee and fulltime onsite QA supervision, during erection & commissioning, by the supplier of the lining system.<br><br>External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet.<br>……<br>……< 18 at Design Point | A "wet Chimney" shall be ……without FGD system in operation. The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. **The top flue liner above the roof slab shall be made of solid C276 / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness.** External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. The wet stack shall be designed as per the guidelines of EPRI Revised Wet Stack Design Guide.<br>Alternatively, …… year full replacement guarantee and fulltime onsite QA supervision, during erection & commissioning, by the supplier of the lining system.<br><br>External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet. |

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| | | | | | | ……<br>……..<br>18 at Design Point |
| 120. | **Sl.no. 176**<br>AMENDMENT NO. CS-0011-109(1A)-2-AMDT-03(T) | | 106 of 117 | | All the gates shall be designed for tight shut off. The Guillotine gate type dampers mentioned at ……. condition without the use of seal air fans of the damper. The Guillotine gates shall also be provided with a 2X100% complete seal air system. The bypass damper shall …….. minimum one type of damper of each type and size. | All the gates shall be designed for tight shut off. The Guillotine gate type dampers mentioned at ……. condition without the use of seal air fans of the damper. **The motor operated Guillotine gates shall also be provided with a 2X100% complete seal air system.** The bypass damper shall …….. minimum one type of damper of each type and size. |
| 121. | **Sl.no.05**<br>AMENDMENT NO. CS-0011-109(1A)-2-AMDT-04(T) | | | | **Waste Water**<br>The Contractor guarantees that the maximum purge flow rate to waste water treatment system for Barh-I (3X660 MW) shall be 30 m3/hr averaged over a 24 hour period and for Nabinagar (4x250 MW) shall be 20 m3/hr averaged over a 24 hour period. | **Waste Water**<br><br>The Contractor guarantees that the maximum purge flow rate to waste water treatment system shall be **10m$^3$/hr (except for BRBCL where it shall be less than 5 m$^3$/hr) averaged over a 24 hour period from each unit.** |

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| 122. | **Sl.no. 144** AMENDMENT NO. CS-0011-109(1A)-2-AMDT-03(T) | | 94 of 117 | | Clean gas from the absorber shall be taken to the Wet Chimney, to be provided by the Contractor, through three stage mist eliminators. Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper & Gate is included in the scope of the Contractor. | Clean gas from the absorber shall be taken to the Wet Chimney, to be provided by the Contractor, through three stage mist eliminators. Provision shall be made for facilitating operation of unit with FGD bypass through existing stack. All modifications required including providing bypass damper is included in the scope of the Contractor. |
| 123. | VI/B | I-M1 | 14 of 51 | 5.01.00 A (iv) | (iv) The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side. | (iv) The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side. **In order to optimise power consumption of FGD system at part load operation, Bidder to provide atleast one slurry recirculation pump preferably lower level with Variable Frequency Drive (VFD).** |
| 124. | VI/B | I-M1 | 31 of 51 | 10.01.00 | The tanks shall be of welded construction. Interior surface of the tanks shall be lined with replaceable chlorobutyl/bromobutyl rubber lining of minimum 5 mm thickness and the outside surface shall be coated with paint as approved by the Employer | The tanks shall be of welded construction. Interior surface of the tanks shall be lined with **the following:** **- Wastewater tank , Filtrate tank, Secondary hydro cyclone feed tank : Vinyl ester based Flake lining of min 3 mm thickness** |

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| | | | | | | **- Slurry tanks : Replaceable chlorobutyl /bromobutyl Rubber lining of minimum 4 mm thickness**<br><br>The outside surface **of the tanks** shall be coated with paint as approved by the Employer. |
| 125. | VI/B | I-M1 | 33 of 51 | 12.01.00 | Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor may provide a recirculation line with motorized isolation valve for the above purpose. | Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor may provide a recirculation line with motorized isolation valve **/ restriction orifice made of erosion resistant material** for the above purpose. |
| 126. | VI/B | III-C7 | 2 of 5 | 2.09.00 | Flanged valves shall be rated at no less then ANSI press class of 300 lbs. | Flanged valves shall be rated at no less then ANSI press class of **150 lbs.** |
| 127. | VI/B | -I-M9 | 15 of 24 | MDL<br>387<br>388 | GA Drawing & Datasheet of 12T Hoist for Ball Mill Building GA & Datasheet of 25T Hoist | GA Drawing & Datasheet of Hoist for Ball Mill Building GA & Datasheet of Hoist |
| 128. | VI | I-M1 | 19 of 51 | 5.06.18 | In case the absorber is equipped with several spray levels they shall be designed as follows:<br><br>(i) The last spray level upstream the mist eliminator shall be operated only in counter flow.<br>(ii) ……..<br>(iii) ……..<br>(iv) …….. | In case the absorber is equipped with several spray levels they shall be designed as follows:<br><br>(i) **For spray type Absorber,** the last spray level upstream the mist eliminator shall be operated only in counter flow.<br>(ii) …….<br>(iii) ……. |

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| | | | | | | (iv) …… |
| 129. | VI | I-M1 | 8 of 51 | 4.01.01 3(iii) | Pressure at Booster Fan suction \| 0 mmWc | Pressure at terminal point before Booster Fan suction \| 0 mmWc |
| 130. | VI/B | I-M1 | 27 of 51 | 7.07.05 | The secondary wastewater underflow shall be taken to the adequately sized filtrate tank, while the overflow shall be taken to a wastewater tank. | The secondary wastewater underflow shall be taken to the adequately sized filtrate tank while the overflow shall be taken to a wastewater tank.<br>**In case Bidder opts to provide additionally Lamella separator before the waste water tank and after the secondary hydro cyclone for removing impurities from the system, the solids concentration in waste water up to max 10% can be acceptable .However, the required moisture content in Gypsum & required Gypsum quality shall be complied.** |
| 131. | | | | | ZLD envisaged for Barh (3x660 MW) & BRBCL (4x250MW) | **ZLD stands deleted for both these projects (Barh-I (3x660 MW) & BRBCL (4x250MW)). Accordingly, all clauses and Drgs indicated in the specification pertaining to ZLD will not be applicable and clauses and drgs indicated in the** |

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| | | | | | | **specification related Wastewater treatment system shall be applicable to these two projects also.** |
| 132. | VI/A | IV | 2 of 3 | 1.08.00 | **Waste Water**<br>FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank , and 300 mm above FFL in HCSD Silo Area. Pressure at terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be <50°C. | **Waste Water**<br>FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank , and 300 mm above FFL in HCSD Silo Area. Pressure at terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be <50-60°C.<br>**For (Barh-I (3x660 MW) & BRBCL (4x250MW):-**<br>**FGD waste water pipes shall terminate along with isolation valve ash slurry sump. PH shall be 7.0 (approx.) and temperature shall be <50-60°C at terminal point.** |
| 133. | VI/A | VII | 1 of 61 | 1.01.00 a) | The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares | The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the |

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| | | | | | shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item. | price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish **total population of each item for the project** in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item. |
| 134. | VI/A | VII | 6-11 of 61 | 1.01.00-1.17.00 | Mandatory Spares List (For each Project)<br>Cl. No. 1.01.00 to 1.17.00 | Mandatory Spares List (For each Project) - Cl. No. 1.01.00 to 1.17.00 revised attached as **Mech Annexure III** |
| 135. | VI/A | VII | 44 of 61 | Note to cl. No. 1.24.00 | Note | Add below Note:-<br>6**. Wherever rubber part viz: coupling, V belt, flexible hose etc have been used ,minimum quantity as specified above is to be supplied and any item which is not covered above minimum 10% or 01 no whichever is higher is to be supplied.**<br>7**. Wherever nonmetallic fabric/paper filter etc have been used ,minimum quantity as specified above is to be supplied and any item which is not covered above minimum 10% or 01 no whichever is higher is to be supplied**<br>8**. Any special tool required for maintenance of any of the equipment being supplied is to be included in** |

## AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. NO. | SPECIFICATION REFERENCE | | | | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | SEC/ PART | SUB SEC. | PAGE NO. | CLAUSE NO. | | |
| | | | | | | **mandatory T&P along with the equipment.** |
| 136. | Section-VI, Part A | VI | 5.00.00 | 20-23 of 24 | **AUXILIARY POWER CONSUMPTION(PA) FOR EACH PROJECT** | **Revised AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT is enclosed at Mech Annexure-IV** |
| 137. | | | | | -- | In case distance from Limestome Grinding system/ Gypsum Dewatering and Absorber is more than 500M, Bidder shall provide the following :-<br>Flushing system at intermittent locations for the lime stone slurry pipeline which shall contain tank and pumps. Intermittent location distance of flushing system shall be based on their proven practice. |
| 138. | VI/B | I:M9 | 1 to 24 of 24 | MDL List | MDL List no.<br>213.Motor for Booster Fan - Sub QR documents of M/s Crompton Greaves Ltd., Bhopal<br>214. Motor for Booster Fan - Sub QR documents of M/s Weg, Hosur<br>215. Motor for Booster Fan - Sub QR documents of M/s Crompton Greaves Ltd., Mandideep<br>433. Oxidation Blower - Sub QR documents of M/s ITO, Japan<br>434.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Thysencrupp, Germany | MDL List no.<br>213.Motor for Booster Fan - Sub QR documents<br>214. Motor for Booster Fan - Sub QR documents<br>215. Motor for Booster Fan - Sub QR documents<br>433. Oxidation Blower - Sub QR documents<br>434.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents 435.Recirculation Slurry Pump - Sub QR documents 436.Booster Fan - Sub QR documents |

## AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. NO. | SPECIFICATION REFERENCE | | | | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | SEC/ PART | SUB SEC. | PAGE NO. | CLAUSE NO. | | |
| | | | | | 435.Recirculation Slurry Pump - Sub QR documents of M/s DUCHTING PUMPEN, GERMANY<br>436.Booster Fan - Sub QR documents of M/s Solyvent Flakt AB, Sweden<br>437.Slurry Pump - Sub QR documents of M/s Duchting Pumpen, Germany<br>438.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Metso, USA<br>439.Agitators - Sub QR documents of M/s EKATO RMT GMBH. Germany<br>440.Vaccume Belt Filters - Sub QR documents of M/s Shanghai Xuhe Environmental Technology Co. Ltd., Shanghai, China<br>441.Vaccume Belt Filters - Sub QR documents of M/s FLSmidth, USA<br>442.Agitators - Sub QR documents of M/s Zhejiang Greatwall Reducer Mfg Co. Ltd.<br>443.Gas to Gas Heat Exchanger (GGH) - Sub QR documents<br>444.Slurry Pump - Sub QR documents of M/s Weir Minerals, USA<br>445.Slurry Pump - Sub QR documents of M/s Sam Turbo Industries Pvt. Ltd., Koimbatoor<br>446.Booster Fan - Sub QR documents of M/s Suewon Poongryuk Machinery Co. Ltd, Korea<br>447.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Cemtec, Austria | 437.Slurry Pump - Sub QR documents 438.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents<br>439.Agitators - Sub QR documents<br>440.Vaccume Belt Filters - Sub QR documents<br>441.Vaccume Belt Filters - Sub QR documents<br>442.Agitators - Sub QR documents<br>443.Not used<br>444.Slurry Pump - Sub QR documents 445.Slurry Pump - Sub QR documents 446.Booster Fan - Sub QR documents 447.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Cemtec, Austria<br>448.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Christian Pfeiffer Maschinenfabrik¿ Austria<br>449. Oxidation Air Blower - Sub QR documents of m/s Siemens Turbo Machinery / HV Turbo<br>602. MQP for PDB of M/s pyrotech Electronics Udaipur<br>628. MQP for foundation bolts M/s Quality Engineering Works, Kolkata<br>629. MQP for foundation bolts M/s Indiana Conveyors, Jejuri<br>671. MQP for Ball Valve (M/s Leader)<br>-All drgs pertaining to GGH stands deleted |

## AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. NO. | SPECIFICATION REFERENCE | | | | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | SEC/ PART | SUB SEC. | PAGE NO. | CLAUSE NO. | | |
| | | | | | 448.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Christian Pfeiffer Maschinenfabrik Austria<br>449. Oxidation Air Blower - Sub QR documents of m/s Siemens Turbo Machinery / HV Turbo<br>602. MQP for PDB of M/s pyrotech Electronics Udaipur<br>628. MQP for foundation bolts M/s Quality Engineering Works, Kolkata<br>629. MQP for foundation bolts M/s Indiana Conveyors, Jejuri<br>671. MQP for Ball Valve (M/s Leader)<br>-All drgs pertaining to GGH | |
| 139. | VI/A | A -10 | 14 of 24 | | Drawing not attached | **The drawing for Equipment layout at EL 0.0M (Drg. no. 9558-999-POM-A-001) for Barh-1 project is attached as Mechanical Annexure V** |
| 140. | | | | | Barh-I (3X660MW) clauses and drgs indicated considering that FGD outlet will led to New Chimney. | **Barh-I (3X660MW) clauses and drgs revised considering that FGD outlet will led to existing chimney and accordingly absorber discharge will be connected to ID fan discharge duct with additional damper(s). Bypass duct from bypass damper to chimney and existing chimney shall be lined. Further, Condensate** |

## AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. NO. | SPECIFICATION REFERENCE | | | | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | SEC/ PART | SUB SEC. | PAGE NO. | CLAUSE NO. | | |
| | | | | | | **draining system and condensate study shall also be in the bidder's scope.**<br>**Sketch and details are enclosed at Mechanical Annexure-VI.** |
| 141. | VI/A | I | 9 of 19 | 4.01.07 | In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.01 (e) above, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (e) above for the Slurry Recirculation Pumps. Before ---- equipment. | In case the Bidder or the proposed sub-vendor is a manufacturer of Pumps, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps **and slurry pumps**, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause **4.01.01 (b) &** 4.01.01 (e) above for the Slurry Recirculation Pumps **and slurry pump respectively**. Before --- equipment. |
| 142. | VI/A | V | 10 of 26 | Notes for clause no. 6.000 | Notes:- | Following note is added.<br>Note:-<br>**3.For the purpose of sizing of equipments and guarantee, MgCO3 shall be considered as unreactive dolomitic form.** |
| 142 (a) | VI/B | I-M1 | 8 of 51 | 4.01.00 | The Booster ------specified range of fuels. Additionally a pressure loss of 100 mm wcl (excluding margin) shall be built up in booster fan design criteria as mentioned below to take care of pressure loss due to future installation of | The Booster ------specified range of fuels. Additionally a pressure loss of 100 mm wcl (**including margin**) shall be built up in **both** booster fan design criteria as mentioned below to take care of pressure loss due to future installation of De-N**O**x system. |

## AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. NO. | SPECIFICATION REFERENCE | | | | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | SEC/ PART | SUB SEC. | PAGE NO. | CLAUSE NO. | | |
| | | | | | De-Nox system. | |
| 142 (b) | VI/A | III-A1 | 9 of 9 | 25.00.05 | A common Nickel based alloy material storage/neutralizing tank for the both the units of storage capacity of 12 hrs of stack condensate of both the stack shall be provided. Storage tank/neutralization tank shall be complete with dosing, mixing and<br>preparation system. After neutralization of the stack condensate collection, same shall be pumped to common drain system. Contractor shall provide 2 X100% pumps, complete with valves, piping fittings, level control/monitoring etc. Alternatively, bidder may propose its proven system for disposal of the condensate system in its bid for Employer's consideration. All the material in contact with the condensate shall be of suitable material for the operating duty. | **Bidder should provide the condensate collection system such that the condensate collected shall be routed to absorber by gravity, bidder should ensure safe discharge to the absorber. However, in-case of the distance between absorber and wet stack is considerably far, bidder should provide the condensate collection system such that condensate shall be collected in a storage tank and pumped to absorber. Tank shall be placed at zero meter with a capacity 5 m3/hr along with associated pumping system.**<br><br>**A common storage tank for the both the units of storage capacity of 5 m3/hr of stack condensate of both the stack shall be provided. Storage tank shall be complete with stack condensate collection be pumped to absorber.** Contractor shall provide 2 X100% pumps, complete with valves, piping fittings, level control/monitoring etc. Alternatively, bidder may propose its proven system for disposal of the condensate system in its bid for Employer's consideration. All the material in |

## AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. NO. | SPECIFICATION REFERENCE | | | | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | SEC/ PART | SUB SEC. | PAGE NO. | CLAUSE NO. | | |
| | | | | | | contact with the condensate shall be of suitable material for the operating duty. |
| 142 (c) | Sl. No.-165 AMENDMENT NO. CS-0011-109(1A)-2-AMDT-03(T) | | 101 of 117 | | 2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower will be used for supplying a variable volume of air to the absorber reaction tank. | 2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type **/ positive displacement (Helical lobe) type with VFD drive,** oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower will be used for supplying a variable volume of air to the absorber reaction tank. |
| 143. | SECTION-VI, PART-B | I-M1 | 33 OF 51 | 12.02.00 | All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes of **size lower than 3"** made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. | All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes of **size lower than 300 NB** made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. **Outer surface of the pipes should be fire retardant.** |
| 144. | VI/B | I-M1 | 19 of 51 | 5.06.11 & Refer the Sl.No.178 of Amendment No. CS-0011- | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br>The absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br>The absorber oxidation tank, absorber tower & absorber outlet duct up **to absorber outlet flange** shall be provided with 2 mm (minimum) thickness lining / cladding / Alloy C276 / Alloy 59 or better material. |

## AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

| SL. NO. | SPECIFICATION REFERENCE | | | | EXISTING | READ AS |
|---|---|---|---|---|---|---|
| | SEC/ PART | SUB SEC. | PAGE NO. | CLAUSE NO. | | |
| | | | | 109(1A)-2-AMDT-03(T) | | |
| 145. | VI/B | I-M1 | 17.01.00 | 42 of 51 | Thermal Insulation along with aluminum cladding shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius. | Thermal Insulation along with aluminum cladding shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius **except for absorber. Further, Thermal insulation of min 70 mm shall be provided for absorber outlet flue gas duct irrespective of skin temperature.** |

## 10.00.00 ANALYSER INSTRUMENTS (OTHER THAN CEMS)

### 10.01.00 Common requirements:-

| | | |
|---|---|---|
| 1 | Type | Microprocessor based with self-indicating type diagnostic feature.<br>Output signal: 4-20 mA DC galvanically isolated.<br>Binary Signal: 2NO+2NC |
| 2 | Display | Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer. |
| 3 | Zero & span Adjustment | To be provided for all selectable ranges. |
| 4 | Ambient temp. | 0-50°C unless defined otherwise. |
| 5 | Analyser enclosure Type/Material | Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55. |
| 6 | Calibration | Auto & Manual (from Remote). |
| 7 | Power Supply | To be arranged by Contractor subject to Employer's approval. |
| 8 | Others | i) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to FGD Control system are to be provided by Contractor.<br>ii) All the calibration gases (certified cylinder) required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas. |
| 9 | Compliance to standards | USEPA, TUV, MCERTS or equivalent standards |
| 10 | Type of Technology | SO2/NOx :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type<br>Note:- For Hot extractive sampling type and Dilution extractive sampling type system – The components involved in sample handling system shall be imported & further, Sample handling system design shall be vetted by Original Analyzer Manufacturer (OAM). Necessary documents shall be furnished during detailed engineering in order to establish the above requirement. Technical expert of OAM shall witness testing of sample handling system and validate it. Alternatively sampling handling system assembled at Original Analyzer manufacturer (OAM) works shall also be accepted. |
| 11 | Measurement range, tapping point | As per FGD system design and process parameters. |

Note: Analysers shall be placed inside CONTAINERISED ROOM (PORTABLE CABIN) provided by the contactor. For detailed specification of CONTAINERISED ROOM

(PORTABLE CABIN), Contractor to refer Sub section IIIC-11, Part-B, Section-VI of technical specification.

**10.02.00 Specific requirements for Hot-extractive sampling type SO2 analysers**

| **Specification Requirements** | **SO2 Analyser** |
|---|---|
| Type of Instrument | Sampling type - Hot Extractive type |
| Principle of Measurement | Radiation absorption |
| Accuracy | +/- 1% of lowest measurement range or better |
| Linearity | ≤ +/-1% of lowest measurement range |
| Repeatability | ≤ 1% of lowest measurement range |
| Minimum detection limit | ≤ 0.5% of lowest measurement range |
| Temperature Drift | ≤ +/- 2%/10 Deg.C |
| Zero Drift | ≤ +/-1% of lowest measurement range /week |
| Span Drift | ≤ +/-1% of lowest measurement range /week |
| Analyser Response time (up to 90% of full scale) | ≤ 5 secs |
| Operating Temperature Range for probe | 0-300 deg.C |
| Filter | Ceramic 3.5 Micron |
| Accessories for purging system | Purging system including Auto Scavenging facility shall be provided |
| Sample gas inlet temperature to analyser | Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards**.** |

**10.03.00 Specific requirements for Dilution Extractive type SO2 Analsyers**

The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:

a) Modular Electronic Design.
b) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NOx/CO2/SO2 from air and accumulator.
c) Self test facility with screen display.

d) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit.
e) The following are the minimum requirement for the probe:-

- Flange and counter flange for inserting probe
- Flange and counter flange for inserting probe
- Coarse and Fine Filters
- Critical orifice
- Automatic blow back or purging facility
- SS316L probe material

f) Further dilution probe controller shall be provided with the ability to control dilution ratio.
g) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE.

| **Specification Requirements** | **SO2 Analsyer** |
|---|---|
| Principle of measurement | Pulsed/UV Fluorescence technology. |
| Probe operating temp | 0-300 deg C |
| Accuracy | +/- 1% of lowest measurement range or better |
| Linearity | ≤ +/-1% of lowest measurement range |
| Repeatability | ≤ 1% of lowest measurement range |
| Minimum detection limit | ≤ 0.5% of lowest measurement range |
| Zero drift | ≤ +/-1% of lowest measurement range/week |
| span drift | ≤ +/-1% of lowest measurement range/week |
| Response time (up to 95% of full scale) | 100 sec |
| Sample gas inlet temperature to analyser | 5 deg.C - 40 deg.C |

**10.04.00 Specific requirements for In-situ (Path) type SO2 analysers**

| **Specification Requirements** | **SO2 Analyser cum monitor** |
|---|---|
| Principle of Measurement | Differential Optical Absorption Spectroscopy |
| Accuracy | +/- 1% of lowest measurement range or better |
| Linearity | ≤ +/-1% of lowest measurement range |

| | |
|---|---|
| Repeatability | ≤ 1% of lowest measurement range |
| Minimum detection limit | ≤ 0.5% of lowest measurement range |
| Temperature Drift | ≤ +/- 2%/10 Deg.C |
| Zero Drift | ≤ +/-1% of lowest measurement range/week |
| Span Drift | ≤ +/-1% of lowest measurement range/week |
| Response time(up to 90% of full scale) | ≤ 5 sec |
| Probe Operating Temperature Range | 0 to 300 deg C |
| Accessories for purging system | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. |
| Temperature compensation | Automatic temperature compensation to be provided |

**10.05.00 pH Analyser**

| | | |
|---|---|---|
| **a)** | **Type** | **:** Cell - flow through |
| **b)** | **Accuracy** | **:** < ± 1% of reading |
| **c)** | **Range** | **:** 0 - 14 pH freely programmable (For others) |
| **d)** | **No. of steams** | **:** Single |
| **e)** | **Temp. compensation** | **:** Automatic |

**11.00.00 CONTINUOUS EMISSION MONITORING SYSTEM (CEMS):-**

(i) CEMS comprising of analysers and associated items for measurement of SO2, NOx, CO, CO2, Mercury, Particulate Matter (dust density) monitor and Stack Flue Gas Flow in Stack emission shall be provided by the Contractor.

(ii) Direct measurement of NO and NO2 shall be done. Total NOx values shall be reported as NO2 i.e. NOx = NO + NO2 = NO X 1.53 + NO2 = NOx as NO2.

(iii) Oxygen (O2) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for correction of SO2, NOx and Particulate matter value corresponding to the standard/reference O2.

(iv) CEMS Parameters shall be normalized for temperature, pressure, moisture (applicable in case wet measurement techniques), etc. This facility shall be available

in the respective analysers. Necessary measurement shall be provided by the Contractor for these parameters. All the CEMS parameters shall be reported on dry basis.

(v) CO2 Measurement at stack and at instrument end shall be provided in case dilution techniques are used.

(vi) CEMS analysers for which dual ranges are specified shall be calibrated for range near to operating process value.

(vii) Offered CEMS should be capable of operating unattended over the prolonged period of time.

(viii) CEMS analysers shall be placed inside CONTAINERISED ROOM (PORTABLE CABIN) provided by the contactor. For detailed specification of CONTAINERISED ROOM (PORTABLE CABIN), Contractor to refer Sub section IIIC-11, Part-B, Section-VI of technical specification.

The common requirements to be met for all types of analysers are as below. The specific requirements to be met by each type of analyser are detailed in the subsequent clauses.

**11.01.00 Common Requirements for all Analysers**

| | | |
|---|---|---|
| 1 | Type | Microprocessor based with self-indicating type diagnostic feature.<br>Output signal: 4-20 mA DC galvanically isolated.<br>Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol shall be provided in CEMS analysers for bidirectional communication of stack emission data to Employer's cloud server. |
| 2 | Display | Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer. |
| 3 | Zero & span Adjustment | To be provided for all selectable ranges. |
| 4 | Ambient temp. | 0-50°C unless defined otherwise. |
| 5 | Analyser enclosure Type/Material | Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55. |
| 6 | Calibration | Auto & Manual (from Remote). CEMS analyser should have inbuilt zero and calibration check capability. |
| 7 | Power Supply | To be arranged by Contractor subject to Employer's approval. |
| 8 | Others | i) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to DCS (in respective unit control room) are to be provided by Contractor.<br>ii) All the calibration gases (certified cylinder) required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas. |

| | | |
|---|---|---|
| 9 | Location of probe | SO2/NOx/CO/CO2-On stack at approximate elevation of 35 Mtrs.<br>Particulate Matter (Dust Density) & Flow measurement -On stack at approximate elevation of 88 Mtrs<br>Mercury:- On stack at approximate elevation of 35 Mtrs |
| 10 | Location of the analysers (other than insitu type)/Analyser Panel. | AT 0' Mtrs near stack for CEMS analysers except particulate matter analyser. For particulate matter preferred location is '0' meter near stack. Remote display cum configuration unit for particulate matter analyser should be provided at '0' meter near stack in the analyser panel in case particulate matter analyser is kept near the sample point due to technical limitation. |
| 11 | Compliance to standards | USEPA, TUV, MCERTS or equivalent standards |
| 12 | Type of Technology | SO2/NOx :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type<br>CO :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type. (can be combined with SO2/NOx)<br>CO2 :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type (can be combined with CO or SO2/NOx above).<br>Particulate Matter (Dust Density):- Extractive type with reheating or dilution.<br>Mercury (Hg) :- Hot extractive type<br>Note:- For Hot extractive sampling type and Dilution extractive sampling type system – The components involved in sample handling system shall be imported & further, Sample handling system design shall be vetted by Original Analyzer Manufacturer (OAM). Necessary documents shall be furnished during detailed engineering in order to establish the above requirement. Technical expert of OAM shall witness testing of sample handling system and validate it. Alternatively sampling handling system assembled at Original Analyzer manufacturer (OAM) works shall also be accepted. |
| 13 | Contractual conditions for CEMS system | Warranty:- As defined elsewhere in the Contract.<br>Comprehensive Annual Maintenance Contract:-. Refer sub-section-IIC-C& I/ Section-VI/ Part-A. This shall cover total maintenance of all hardware and software related to CEMS and shall include free repair/replacement of all components/cables/equipment etc and supply of expendable items.<br>Availability of valid data:-AT least 90% of time during warranty and CAMC period. For this purpose, contractor may take necessary steps to ensure availability.<br>Services to be provided during Warranty and CAMC period shall be as per clause no. 2.04.00, 2.05.00 and 2.06.00, Sub-Section-III-C, SECTION-VI, PART-A. |

**11.02.00 Specific requirements for Hot-extractive sampling type SO2, NOx, CO2 & CO analysers**

| **Specification Requirements** | **SO2 Analyser and Nox Analyser cum monitor (combined)** | **CO2 ANALYZER** | **CO Analyser** |
|---|---|---|---|
| Type of Instrument | Sampling type - Hot Extractive type | Hot-Extractive | Hot-extractive type |
| Principle of Measurement | Radiation absorption | NDIR absorption | NDIR absorption |
| Measurement Range | 0-100 / 0-1000 mg/Nm3 (selectable) | 0 to 25% (selectable) | 0-100/ 0-1000 mg/Nm3 (selectable) |
| Accuracy | +/- 1% of lowest measurement range or better | +/- 1% of Span or better | +/- 1% of lowest measurement range or better |
| Linearity | ≤ +/-1% of lowest measurement range | ≤ +/-1% of lowest measurement range | ≤ +/-1% of lowest measurement range |
| Repeatability | ≤ 1% of lowest measurement range | ≤ 1% of lowest measurement range | ≤ 1% of lowest measurement range |
| Minimum detection limit | ≤ 0.5% of lowest measurement range | ≤ 0.5% of lowest measurement range | ≤ 0.5% of lowest measurement range |
| Temperature Drift | ≤ +/- 2%/10 Deg.C | ≤ +/- 2% / 10 Deg.C | ≤ +/- 2%/10 Deg.C |
| Zero Drift | ≤ +/-1% of lowest measurement range /week | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week |
| Span Drift | ≤ +/-1% of lowest measurement range /week | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week |
| Analyser Response time (up to 90% of full scale) | ≤ 5 secs | ≤ 5 secs | ≤ 5 secs |
| Operating Temperature Range for probe | 0-300 deg.C | 0-300 deg.C | 0-300 deg.C |
| Filter | Ceramic 3.5 Micron | Ceramic 3.5 Micron | Ceramic 3.5 Micron |

| | | | |
|---|---|---|---|
| Accessories for purging system | Purging system including Auto Scavenging facility shall be provided | Purging system including Auto Scavenging facility shall be provided | Purging system including Auto Scavenging facility shall be provided |
| Sample gas inlet temperature to analyser | Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards. | Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards. | Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards. |

**11.03.00 Specific requirements for Dilution Extractive type SO2, NOx, CO2 & CO Analsyers**

The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:

h) Modular Electronic Design.
i) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NOx/CO2/SO2 from air and accumulator.
j) Self test facility with screen display.
k) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit.
l) The following are the minimum requirement for the probe:-

- Flange and counter flange for inserting probe
- Flange and counter flange for inserting probe
- Coarse and Fine Filters
- Critical orifice
- Automatic blow back or purging facility
- SS316L probe material

m) Further dilution probe controller shall be provided with the ability to control dilution ratio.
n) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE.
o) Any dilution extractive system must have CO2 measurement facility at source/stack and measuring point/instrument end to prove the correctness of the selected dilution ratio.

| **Specification Requirements** | **SO2 Analsyer** | **NOx Analsyer** | **CO2 Analsyer** | **CO Analsyer** |
|---|---|---|---|---|
| Principle of measurement | Pulsed/UV Fluorescence technology. | Chemiluminescence technology. | Gas Filter correlation | Gas Filter Correlation technology |
| Measurement Range | 0-100 / 0-1000 mg/Nm3 (selectable) | 0-100 / 0-1000 mg/Nm3 (selectable) | 0 to 25% (selectable) | 0-100/ 0-1000 mg/Nm3 (selectable) |
| Probe operating temp | 0-300 deg C | 0-300 deg C | 0-300 deg C | 0-300 deg.C |
| Accuracy | +/- 1% of lowest measurement range or better | +/- 1% of lowest measurement range or better | +/- 1% of lowest measurement range or better | +/- 1% of lowest measurement range or better |
| Linearity | ≤ +/-1% of lowest measurement range | ≤ +/-1% of lowest measurement range | ≤ +/-1% of lowest measurement range | ≤ +/-1% of lowest measurement range |
| Repeatability | ≤ 1% of lowest measurement range | ≤ 1% of lowest measurement range | ≤ 1% of lowest measurement range | ≤ 1% of lowest measurement range |
| Minimum detection limit | ≤ 0.5% of lowest measurement range | ≤ 0.5% of lowest measurement range | ≤ 0.5% of lowest measurement range | ≤ 0.5% of lowest measurement range |
| Zero drift | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week |
| span drift | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week |
| Response time (up to 95% of full scale) | 100 sec | 60 sec | 90 sec | 60 sec |
| Sample gas inlet temperature to analyser | 5 deg.C - 40 deg.C | 5 deg.C - 40 deg.C | 5 deg.C - 40 deg.C | 5 deg.- 40 deg.C |

**11.04.00 Specific requirements for In-situ (Path) type SO2, NOx, CO2 & CO analysers**

| Specification Requirements | SO2/NOx Analyser cum monitor | CO2 Analyser cum monitor | CO Analyser cum monitor |
|---|---|---|---|
| Principle of Measurement | Differential Optical Absorption Spectroscopy | Differential Optical Absorption Spectroscopy | IR absorption |
| Measurement Range | 0-100 / 0-1000 mg/Nm3 (selectable) | 0-25% (selectable) | 0-100/ 0-1000 mg/Nm3 (selectable) |
| Accuracy | +/- 1% of lowest measurement range or better | +/- 1% of lowest measurement range or better | +/- 1% of lowest measurement range or better |
| Linearity | ≤ +/-1% of lowest measurement range | ≤ +/-1% of lowest measurement range | ≤ +/-1% of lowest measurement range |
| Repeatability | ≤ 1% of lowest measurement range | ≤ 1% of lowest measurement range | ≤ 1% of lowest measurement range |
| Minimum detection limit | ≤ 0.5% of lowest measurement range | ≤ 0.5% of lowest measurement range | ≤ 0.5% of lowest measurement range |
| Temperature Drift | ≤ +/- 2%/10 Deg.C | ≤ +/- 2%/10 Deg.C | ≤ +/- 2%/10 Deg.C |
| Zero Drift | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week |
| Span Drift | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week | ≤ +/-1% of lowest measurement range/week |
| Response time(up to 90% of full scale) | ≤ 5 sec | ≤ 5 sec | ≤ 5 sec |
| Probe Operating Temperature Range | 0 to 300 deg C | 0 to 300 deg C | 0 to 300 deg C |
| Accessories for purging system | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. | Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure. |
| Temperature compensation | Automatic temperature compensation to | Automatic temperature compensation to be | Automatic temperature compensation to be provided |

| | | | |
|---|---|---|---|
| | be provided | provided | |

**11.05.00 Specific requirements for Particulate Matter (Dust density) monitor**

| **Specification Requirements** | **PARTICULATE EMISSION (Dust density Stack Opacity) monitor** |
|---|---|
| Type of Instrument | Extractive type with reheating or dilution. |
| Principle of Measurement | Scattered Light measurement |
| Measurement Range | 0-50 mg/Nm3 / 0 - 300 mg/Nm3 (Programmable) |
| Accuracy | +/- 2% of lowest measurement range or better |
| Linearity | ≤ +/- 1% of lowest measurement range |
| Repeatability | ≤ 1% of lowest measurement range |
| Minimum detection limit | ≤ 1% of lowest measurement range |
| ~~a)~~ Temperature Drift | ≤ +/- 2%/10 Deg.C |
| ~~b)~~ Zero Drift | ≤ +/-1% of lowest measurement range/week |
| ~~c)~~ Span Drift | ≤ +/-1% of lowest measurement range/week |
| Analyser Response time(up to 90% of full scale) | ≤ 5 sec |
| Operating Temperature Range for probe | 0-300 deg.C |
| Filter | To be provided |
| Accessories purging system | Purging system to be provided. |
| Temperature compensation/measurement | Temperature compensation to be provided, if applicable. |
| | First site Calibration of the instrument should be done based on the results of an extractive IsoKinetic Test by the Contractor. |

**11.06.00 Specific requirements for Continuous On-line Mercury Analyser**

| S.NO. | PARAMETER | DETAILS |
|---|---|---|
| 1 | Measurement Principle | Atomic Absorption Spectrometry/ Atomic Fluorescence spectrometry. |
| 2 | Range | 0 - 35 microgram/Nm3 |
| 3 | Accuracy | +/- 1% of Span or better |
| 4. | Minimum detection limit | 1 microgram/Nm3 |

**11.07.00 ULTRASONIC FLOW METER FOR FLUE GAS FLOW IN STACK**

| | |
|---|---|
| Type | Microprocessor based with self-indicating type diagnostic feature.<br>Output signal: 4-20 mA DC galvanically isolated.<br>Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol for bidirectional communication of stack emission data to Employer's cloud server. |
| Mounting Style | Transducers on the duct/stack |
| Transducer type and material | Single pair of Corrosion resistant material to be provided |
| Zero and Span adjustment | To be provided |
| Flow measurement | Instantaneous Flow rate as well as totalized flow |
| Power supply Distribution | To be arranged by the Contractor from Employer's terminal point. |
| Display/Indication | Flow meter with LCD screen backlight based local display and keypad . If required, transmitter shall be suitably located away from the sensor for better access and visibility. |
| Recording / Totalizing/Logging Facilities | To be provided |
| Diagnostics | False signal tolerance , power supply failure etc |
| Protection class | IP-65 or better |
| Ambient temperature | -20 deg to +60 deg C |
| Accuracy | +/- 2% of span or better |
| Electrical connection | Plug and socket |
| Accessories | All mounting hardware required like clamping fixtures, mechanism to remove the transducers online, interconnecting cables to DDCMIS, cables, flexible conduits, junction boxes etc |

| | |
|---|---|
| | Purging arrangement for Cleaning sensors to be provided. Material of all fittings shall be SS 316. |
| Software features | Compensation for temperature and pressure and any cross path errors.<br>Programming, configuration, shall be possible from front panel. |

NOTES:-

01. Hot extractive sampling type/ Dilution extractive type systems shall be provided with dual sample probes along with all required accessories such as redundant heavy duty pumps with continuous rated motors, moisture detection facility, pre-fabricated heated (for sampling type only) sample lines from probes to analyser panel, solenoid valves, filters, coolers along with level switch in gas coolers for auto draining purpose and flow meter etc as applicable. Alternatively, permeation based dryer (located near the tapping point) alongwith necessary sample conditioning devices to ensure full protection, to avoid clogging & long life of permeation tubes may also be provided in place of sample cooler. Also, healthiness status/alarm/indication of permeation based dryer shall be provided in analyser panel.

02. In case IR based technique is used for SO2/NOx measurement, correction for H2O cross interference shall be available in the analyser.

03. If the SOx, NOx, CO2 & CO ( if sampling/dilution type) analyzers do not meet the environmental conditions specified at cl. 7.00.00 of Sub Sec IIIC-01, Section-VI, Part-B, all weather Local Panel fitted with integral Air Conditioner located in non-air conditioned area shall be provided for housing analysers etc.

04. For O2 Analyser, the construction of the sensor shall be such that joints between dissimilar materials are avoided to prevent formation of cracks.

11.08.00 Connectivity with DDCMIS and provision for bidirectional communication with Employer's Cloud Server

1. 4-20mA signals from all the above analysers, flow meters, stack gas temperature, stack pressure, stack gas moisture, stack gas O2 shall be wired to DCS of respective unit.

2. RS232/ RS485 Modbus protocol/ Ethernet TCIP/IP protocol for bidirectional communication with Employer's Cloud Server as defined in Sub-section-IIIC-C&I/ Section-VI/ Part-A.

All the accessories and cables required for connecting Analysers outputs to DCS and provision of bidirectional communication as defined above shall be provided by Contractor on as required basis.

**1.25.00 CONTROL AND INSTRUMENTATION (EXCLUDING AIR CONDITIONING AND VENTILATION SYSTEM, COMPRESSED AIR SYSTEM, FIRE DETECTION AND PROTECTION SYSTEM. For mandatory spare of these systems, refer mandatory spare clauses specified under respective systems)**

| | | |
|---|---|---|
| **1.00.00** | **CONTROL AND INSTRUMENTATION** | |
| **1.01.00** | **MEASURING INSTRUMENTS** | |
| 1.01.01 | (i) Transmitters of all types and model no. (for measurement of pressure, differential pressure, flow, level, temp, etc.). This shall include magnetic/ electromagnetic flow meter, mass flow meter also.<br><br>(ii) Density meter | 10% or 1 no. of each type and model, whichever is more.<br><br>10% or 1 no. of each type and model, whichever is more. |
| 1.01.02 | Temp Elements along with thermo well (except winding temp elements of motor) | 10% or 2 no. of each type, model & length, whichever is more. |
| 1.01.03 | (i) Process Actuated Switches (Pressure, Differential pressure, flow, level, temp)<br><br>(ii) Limit switches (for pneumatic and manual valves) | 10% or 2 no. of each type and model, whichever is more.<br>10% or 2 no. of each type and model, whichever is more. |
| 1.01.04 | Local Gauges for Pressure, Differential pressure, flow, level, temp | 5% or 1 no. of each type, model and range, whichever is more. |
| 1.01.05 | Vibration monitoring system | |
| (i) | Sensors | 10% or Minimum 2 Nos. of each type, make and model whichever is more.<br>*if prefab cable or prefab extension cable is used same should be supplied in proportion. |

| | | |
|---|---|---|
| (ii) | Power Supply Module Cards | 10% or minimum 2 nos which ever is more |
| (iii) | Driver / Interface Cards & all other electronic cards. | 10% or minimum 2 nos which ever is more |
| **1.02.00** | **Continuous Emission Monitoring System (CEMS)** | |
| (i) | Analyzer for SO2, NOx, CO2, CO. | 1 no. complete analyser of each type and model. |
| (ii) | Flue gas flow measurement instrument | 1 no. complete instrument along with sender/receiver unit. |
| (iii) | Analyser for Particulate Matter | 1 no. complete analyser |
| (iv) | Analyser for Mercury | 1 no. complete analyser |
| (v) | O2 Analyser | 1 no. complete analyser |
| (vi) | Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules | 10% of each type, model and rating |
| (vii) | Set of gaskets/O-rings/ seals | 200% of each type, model, rating and size |
| (viii) | Temp. Sensor | 20% of each type and model |
| (ix) | Heater assembly, Coolers/dryers, Pumps, etc.. | 20% of each type and model |
| (x) | Complete Probe with shield assembly (Not applicable for In situ- path) | 1 no. of each type and model |
| (xi) | Solenoids | 2 nos. of each type, model and rating |
| (xii) | Filters, light source, sensor, detector, etc. | 100% of each type, model and rating |
| (xiii) | Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges. | One year supply |
| (xiv) | Blower assembly | 1 no. of each type, size and rating. |
| **1.03.00A** | **Analysers and associated items for other than CEMS** | |

| | | |
|---|---|---|
| (i) | Analysers for SO2, O2, pH | 1 no. complete analyser of each type and model. |
| (ii) | Set of gaskets/O-rings/ seals | 200% of each type, model, rating and size |
| (iii) | Heater assembly, Coolers/dryers, pumps | 20% of each type and model |
| (iv) | Filters, light source, sensor, detector, etc. | 100% of each type, model and rating |
| (v) | Complete Probe with shield assembly (Not applicable for In situ- path) | 1 no. of each type and model |
| (vi) | Solenoids | 2 nos. of each type, model and rating |
| (vii) | Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules | 10% of each type, model and rating |
| (viii) | Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges. | One year supply |

| **2.07.00** | **DISTRIBUTED DIGITAL CONTROL MONITORING AND INFORMATION SYSTEM (DDCMIS)** | |
|---|---|---|
| **Sl No** | **ITEM** | **QUANTITY** |
| **1.** | **HMI Devices** | |
| **A)** | **Work station/PC station/servers** | |
| | (i) OWS with licensed software | 2 nos. of each type and model |
| | (ii)Server/Information Workstation with licensed software (as applicable) | 1 no. of each type and model |
| | (iii)Programmer cum documentation station along with licensed software | 1 no. of each type and model |
| | (iv) Keyboard | 2 nos. of each type and model |
| | (v) Mouse | 4 nos. of each type and model |
| **B)** | **Printers** | |
| | (i) Color laser printer (A4) | 1 no |

| | | |
|---|---|---|
| | (ii)Print head assembly for A4 color laser printer | 2 nos of each type and model |
| **C)** | **Network Components** | |
| | (i)Switch/repeaters/hubs/firewalls for DDCMIS | 2 nos. of each type and model |
| | (ii)Wireless equipment like power supplies ,modems, electronic modules, media converter(if applicable),connectors patch card, antenna etc. | 2 nos. of each type and model |
| | (iii) Any other device/equipment not covered under above items but required to make system complete. | 2 nos. of each type and model |
| **D)** | **Miscellaneous items** | |
| | (i)Hard disk drive unit of each type as offered in main offer complete with disks and other accessories | 4 nos. (to be divided based on main population) |
| | (ii)Bulk Storage drive unit | 2 nos. of each type and model |
| | (iii)Graphic processors modules/Card for work station/server | 2 nos. of each type and model |
| **E)** | Other HMIPIS devices required for Unified HMIPIS which are not covered in above items like protocol converters, stations with software, gateway etc | 10% of each type and model |
| **(F)** | Any other device/items for HMIPIS system which are not covered in above items but are required to make the system complete. | 1 no of each type and model |
| **2**. | Cables and Connectors. | |
| | (i)Prefab interconnecting cables with connectors | 2 no. of each type and length. |
| | (ii)System bus cable with connectors | 2 no. of each type and length. |
| | (iii)I/O bus cable with connectors for remote I/O units | 2 no. of each type and length. |

| | | |
|---|---|---|
| | (iv)Loose Connectors | 5 nos. (sets) of each type |
| **3.** | Power Supply Modules & Power Packs for control system | 20% or 4 nos. of each type model and rating, whichever is more. |
| **4.** | Electronic modules of each type and model for control system, Data communication system, Master and Slave Clock etc. (This shall include all type of cards like I/O cards, Remote I/O cards, communication/Interface cards, controller cards, CPU module or Card, logic cards, etc.) | 20% or 2 Nos of each type, model and rating whichever is more subject to maximum of 20 Nos of each type. |
| **5.** | Bus coupler/Interface hardware / other communication devices. | 20% of each type and model or minimum 2 nos. whichever is more. |
| **6.** | Relays | 10% of each type and model or minimum 2 nos which ever is more |
| **7.** | Batteries used for battery backup of RAMs(If applicable) | 10% of each type and model or minimum 2 nos whichever is more |
| **8.** | Fuses | 200 % of each type and rating |
| **9.** | Cooling fans for Power supply and cabinets. | 10 % of each type and model |
| **10** | Intelligent mini UPS for workstation server, PCs, L3 switch. | 1 no. of each size and rating |
| 11 | For all items of Fieldbus system (including field accessories) except fieldbus cables | 20% or 2 Nos. of each type, model and rating whichever is more subject to maximum of 40 Nos of each type. |
| 12 | Fieldbus cable | 10% of total length used in the project. |

**1.26.00 ELECTRICAL**

| **1.02.00 ELECTRIC ACTUATORS** | | |
|---|---|---|
| **1** | Actuators | 1 no of each type and rating |
| **2** | Electronic PCB of all types | 10% of each type & model |
| **3** | Absolute Encoder (replaceable part) | 5% of each type & model |
| **4** | Electronic Torque sensor | 5% of each type & model |

## 1.22.00 FIRE DETECTION AND PROTECTION SYSTEM

| **7.5** | **PLC CONTROL SYSTEM** | **Quantity** |
|---|---|---|
| 7.5.1 | Power Supply Unit | 1 No. of each type and model, |
| 7.5.2 | Electronic modules(I/O modules, communication modules and any other module used in the system) | 10% or 1 No. of each type and model, whichever is more. |
| 7.5.3 | Central Processor Unit | 1 No. of each type and model |
| 7.5.4 | Interconnecting Cables | 10% of each type & size |
| 7.5.5 | Cooling Fan in PLC system / cabinet | 2 Nos. |
| 7.5.6 | Indication lamps of all types | 100% |
| 7.5.7 | Graphical Interface Unit | 1 No. |
| **7.6** | **24V – DC POWER SUPPLY SYSTEM** | |
| 7.6.1 | CTs, CVTs, VTs, chokes, AC/DC isolators, contactors, timers, relays | 5% or 2 Nos. of each type and rating whichever is more. |
| 7.6.2 | Fuses of each type and rating | 200% |
| 7.6.3 | Fuse free Circuit breakers | 5% or 5 Nos. of each type and rating whichever is more. |
| 7.6.4 | Electronic modules of all types | One No. of each type |
| 7.6.5 | Indication lamps | 100% |
| 7.6.6 | Cooling Fans | 1 No. of each type |
| 7.6.7 | Indicators | 1 No of each type and rating |
| 7.6.8 | Relays of all types including overload relays | 2 Nos. of each type and rating |
| 7.6.9 | Batteries | 5% or 2 nos. of each type & rating whichever is more |

**1.00.00 GENERAL:**

1.01.00 Actuators shall be designed for valve operation to ensure proper function in accordance with specifications given below and complying to EN15714-2 or equivalent. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

1.02.00 This sub-section of specification is applicable for following types of electric actuators:

1.02.01 **Modulating duty electric actuators:**

These shall be provided as per standard practice of OEM of equipment, meeting other requirements of specifications. For specifications of Blade pitch actuators, refer clause no. 5.00.00 of this chapter.

1.02.02 **Electric actuators for valves/ dampers/ gates (other than covered in 1.02.01):**

These actuators shall be Non-Intrusive type electric actuators. The interface of these actuators with DDCMIS shall be of two types viz. with Hardwired interface and with Fieldbus interface. The common requirements of both these type of actuators are specified at clause 2.00.00, specific requirements of Non-Intrusive hardwired actuators are specified at clause 3.00.00 and specific requirements of Non-Intrusive fieldbus actuators are specified at clause 4.00.00. The applications where these two types of actuators are to be provided is specified in Part-A of Technical Specifications.

**2.00.00 COMMON REQUIREMENTS FOR NON INTRUSIVE ELECTRIC ACTUATORS**

**2.01.00 TYPE:**

2.01.01 The actuators shall have integral starters with built in SPP (Single Phasing Preventer). 415 V, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.

2.01.02 The actuators shall be Non- Intrusive electric actuator. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body.

**2.02.00 RATING:**

(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire & 50HZ +/-5%.

(b) Sizing:

Open/Close at rated speed against designed differential pressure at 90% of rated voltage.

For ON/OFF type: Three successive open-close operations or 15 minutes, whichever is higher.

For inching type: 150 starts per hour or required cycles, whichever is higher.

**2.03.00 CONSTRUCTION:**

(a) Enclosure:

Totally enclosed weatherproof, minimum IP-68 degree of protection.

(b) Manual Wheel:

Shall disengage automatically during motor operation.

**2.04.00 MOTOR:**

(a) Type :

Squirrel cage induction motor suitable for Direct On Line ( DOL )starting.

(b) Enclosure:

Totally enclosed, self-ventilated.

(c) Insulation

Class F. Temperature rise 70 Deg C. over 50 Deg C ambient.

(d) Bearings:

Double shielded, grease lubricated antifriction.

(e) Earth Terminals:

Two

(f) Protection:

Single Phasing Protection, Over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design. Suitable means shall be provided to diagnose the type of fault locally.

**2.05.00 POSITION/TORQUE TRANSMITTER:**

The Position/ Limit measurement shall be done using absolute encoders which will give information of position/ limit in both the directions. Electronic measurement of torque shall be provided.

**2.06.00 LOCAL OPERATION:**

It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.

**2.07.00 LCD DISPLAY:**

A local LCD display shall be provided to give information regarding actuator alarms, status and valve position indications as a minimum in local.

**2.08.00 WIRING:**

Suitable voltage grade copper wire.

**2.09.00 TERMINAL BLOCK:**

For power cables, the grade of TBs shall be minimum 650V.

**2.10.00 ACCESSORIES:**

All required accessories (if applicable) for calibration / settings/ configuration of various parameters of actuator shall be provided. For quantities, please refer Part A of technical specifications.

**2.11.00 SIL CERTIFICATION:**

All actuators shall be certified for SIL 2 or better.

**3.00.00 SPECIFIC REQUREMENTS FOR NON INTRUSIVE HARDWIRED ACTUATORS**

**3.01.00 INTERFACES:**

For ON-OFF and INCHING type actuators interface with the control system shall be through hardwired signal only.

(a) Open/Close command, open/ close status and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided hardwired.

(b) The actuator shall be able to accept open/close command at 24V DC with max. 2.5VA load from control system. Accordingly suitable isolated interface in the actuator shall be provided.

(c) Open/close command termination logic shall be suitably built inside actuator.

(d) For typical wiring diagram Refer Tender Drawing No. 0000-999-POI-A-063 (Except plug & socket connector, if not applicable)

**3.02.00 TERMINAL BOX:**

Suitable terminals/ connectors, integral to actuator, for terminating instrumentation & power cables shall be provided. Necessary glands for power cables and instrumentation cables shall be provided.

**3.03.00 TRAINING:**

Contractor shall provide training on Non-Intrusive hardwired Electric Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

**4.00.00 SPECIFIC REQUIREMENTS FOR NON INTRUSIVE FIELDBUS ACTUATORS**

**4.01.00 INTERFACES:**

For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network.

(a) Open/ close commands, open/ close feedback status, disturbance signal etc. shall be available to the Control System through the fieldbus network along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DDCMIS through the fieldbus network.

(b) All actuators shall be Foundation Fieldbus/ Profibus compatible. However the exact protocol shall be based on finalized protocol of DDCMIS. If Profibus DP protocol is envisaged then actuator shall have two (redundant) Profibus DP ports for connecting the redundant Profibus DP cables. That is if one profibus cable is cut or not working/ not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.

(c) Open/close command termination logic shall be suitably built inside actuator.

**4.02.00 TERMINAL BOX:**

Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided. Necessary glands for power cables and armored fieldbus cables shall be provided.

**4.03.00 TRAINING:**

Contractor shall provide training on Non-Intrusive Fieldbus Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

**5.00.00 SPECIFIC REQUIREMENTS FOR BLADE PITCH ACTUATORS**

| Sl No. | Description | Requirement |
|---|---|---|
| 1. | Duty | Continuous duty / Modulation, |
| 2. | Operating Ambient Temperature | -20 to +60 Deg C or better |
| 3. | Enclosure Protection | IP 68 |
| 4. | Resolution/ Precision | 0.1%- 0.2% or better of total travel |
| 5. | Supply Voltage & frequency | 415V +/- 10%, 3 Phase, 50HZ +/-5%<br>or<br>230V +/- 10%, Single Phase, 50Hz +/- 5% |
| 6. | Motor Suitable for | Continuous Duty |
| 7. | Motor insulation Class | F |
| 8. | Analog Control | 4-20mA, (24VDC) |
| 9. | Position Transmitter | 4-20mA (24VDC) |
| 10. | Integral Starter | Yes |
| 11. | Terminal Block | For power cables, the grade of TBs shall be minimum 600V |
| 12. | Accessories (if applicable) | for calibration / settings/ configuration of various parameters of actuator shall be provided |
| 13. | Hand wheel | Yes |
| 14. | Standard Compliance | EN 15714-2 Class D or equivalent |

## 2.01.00 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS

| Sl.No. | Features | Essential/Minimum Requirements |
|---|---|---|
| 1. | Type of Transmitter | Microprocessor based 2 wire type (loop powered), Hart protocol compatible. |
| 2 | Output signal | 4-20 mA DC (Analog) along with superimposed digital signal based on HART protocol |
| 3 | Accuracy | ± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc.<br>+0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2.<br>± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc |
| 4. | Turn down (minimum) | 50:1 for greater than or equal to span of 400mmwcl.<br>20:1 for span below 400mmwcl.<br>10:1 for span greater than 250 kg/cm2 |
| 5. | Stability | 0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer.<br>0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer.<br>0.15% of calibrated range for 5 years for static pressure greater than 250 kg/cm2. |

(Above mentioned (3,4,5 ) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).

| | | |
|---|---|---|
| 6. | Zero and span drift | +/- 0.015 per degC at max span<br>+/-0.11% per degC at min. Span |
| | Power Supply | 24V DC ± 10%. |
| 7. | Load impedance | 500 ohm (minimum) |
| 8. | Housing | Weather proof as per IP-67, metallic housing with durable corrosion resistant coating |
| 9. | Over Pressure | 150% of max. Operating pressure |

| | | |
|---|---|---|
| 10. | Electrical Connection | Plug and socket type except in hazardous area |
| 11. | Process connection | 1/2 inch NPT (F) |
| 12. | Span and Zero | Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility. |
| 13. | Accessories | -Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. |
| | Diagnostics and Display | Self-Indicating feature and digital display |
| 14. | Accessories | 2 valve manifold for absolute & Gauge pressure transmitters,<br>3-valve manifold for Differential Pressure and 5 valve manifold for Level /Flow applications.<br>The valve manifold shall be non integral type (except Fuel Oil area).<br>-For hazardous area, enclosure as described in NEC article 500<br>-2 inch pipe for mounting with Enclosure /Rack/Canopy |
| 15. | Certification | SIL 2 or Better |
| 16. | Adjustment/calibration/maintenance | From hand held HART calibrator |

Notes

LVDT type is not acceptable.

For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement below range of 2000 mmwc

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

## 3.05.00 TEMPERATURE TRANSMITTER (TT)

Following specifications are applicable for Dual input/ Single input temperature transmitter.

Temperature transmitter shall be 2-wire (loop powered) directly powered from 4-20mA input cards of DDCMIS. TT shall be fully compatible with thermocouples and RTDs being

provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself.

| S No. | Features | Essential/Minimum Requirements |
|---|---|---|
| 1. | Output | 2-wire (power supply from input card of control system) with 4-20mA output with superimposed HART protocol signal |
| 2. | Input | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types ( Selectable through HART terminal/calibrator) |
| | Isolation | Min 500 VAC |
| | EMC compatibility | As per EN 61326 |
| | Power supply | 24 V C +/- 10% |
| 3. | Housing | Weather proof as per IP-67, metallic housing with durable corrosion resistant coating |
| 4. | Electrical connection | Plug and Socket connector except hazardous area |
| 5. | Diagnostics & display | Self-Indicating feature and digital display on transmitter |
| 6. | Operating Ambient temperature | 85 deg C without display.<br>70 deg C with display. |
| 7. | Mounting | 2 inch pipe mounting with Canopy. |
| 8. | Accessories | As required by service and operating condition. |
| 9. | Composite Accuracy | (Refer note 2 )<br>RTD =<0.25% of 0-250 deg C span<br>T/C-K type =<0.2% of 0-600 deg C span<br>CJC accuracy (for thermocouples) shall be =< 1 deg C |

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.

2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed in control system.

3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., A/D accuracy, basic accuracy, digital accuracy, etc.) and temperature effect on these

accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.

4. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.

5. Dual input temperature transmitters can also be accepted in place of single input TT.

**15.00.00 Vibration Monitoring System**

The Vibration Monitoring System shall be furnished on a system basis including, vibration transducers, phase marker sensor with low noise flexible cables in flexible conduit, terminated in local terminal boxes, necessary pre-amplifier/electronics mounted in local weather proof boxes, vibration monitors, mounting racks and cabinets etc. The vibration monitoring system shall include all power supplies, interconnecting cabling, calibration equipment, indicators, integrating units, signal conditioning devices and all other accessories, erection hardware required for monitoring of Vibration at each point. The contractor shall provide the vibration pads.

Contractor can offer up to Four Channel Vibration monitors. The allocation of channels shall be such that loss of one monitor shall not affect more than one side of the bearing of one machine. In the case of more than two channel Vibration monitors being provided by the Contractor, then one spare monitor shall be provided mounted in the panel to take care of immediate replacement of any failed monitors. Offered vibration monitors shall be modular in construction, plug in type.

Eddy current / piezoelectric type transducers shall be used. The sensors shall be either proximity or velocity or accelerometer type. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer & suitable for application requirement which shall be finalised during detail engineering and without any extra price. Transducers shall be furnished in weatherproof housing suitable for field conditions. Cables/cabling from transducers local JB to Vibration Monitoring system in Control Room/Control Equipment Room shall be provided by the Contractor.

Vibration monitoring system shall give one no. buffered output of 4-20 mA DC and two no. of buffered raw signal for each point monitored and one no. of buffered raw signal for each phase marker sensor. The 4-20mA signal shall be suitable for use as an input to DDCMIS, linear in proportion to vibration velocity or displacement. Raw buffered signal(s) shall be suitable for archiving and analysis. Monitor shall provide vibration indication calibrated in velocity units along with provisions of changing to displacement unit (field-programmable) for each measurement point in both horizontal & vertical planes. The generation of alarm and trip signals is not envisaged in vibration monitoring system, the same shall be derived in DDCMIS. However in case of vibration initiated protection of equipments, OEM standard and proven practices shall also be considered.

The vibration monitor racks with power supplies shall be mounted in a separate self standing cabinet to be located in control room. The number of racks and power supplies shall be such that on failure of a single power supply/module, not more than four monitors shall be affected. The vibration monitoring cabinet shall be fed from redundant 24V DC feeders with auto changeover scheme.

The power supply arrangement for monitors shall ensure that failure of one power supply shall not affect any monitoring function in the system. Also any power supply failure /earth fault in any of the monitors will be isolated without affecting other monitors/ common power supply. If 230 V AC UPS power supply is required for panel PC/ desktop PC, UPS/Mini UPS for the same shall be provided by the contractor.

The functional requirement for vibration monitoring system shall include but not be limited to the following:

- Vibration monitor front face status indications shall be available for indications of healthy conditions of pick up circuit, monitor circuit and power supply. On sensor fault/wire break in the sensor circuit, the system shall have the feature of identifying the same through suitable means like the signal forced to a value less than 4 mA. In case, such a feature is not available then suitable contact shall be provided from the monitor for sensor fault.
- The facility shall be available for online functional checking of monitors.
- All vibration monitoring equipment shall be functionally tested for circuit continuity and output response. All the components & interconnection cables shall be tested to ensure compliance with the specification requirements & all other applicable codes & standards.

In case it is the proven standard practice of a Contractor to provide vibration monitoring PC with TFT LCD monitor, instead of dedicated monitors with the signal conditioning equipment in control equipment room, the same shall also be acceptable. However, all relevant functional requirements detailed above shall be met and the system shall be subject to Employer’s approval.

## 16.00.00 FIELD INSTRUMENTS BASED ON FIELDBUS

The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter.

### 16.01.00 Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.

| S No. | Features | Essential/Minimum Requirements |
|---|---|---|
| 1. | Type of Transmitter | FOUNDATION Fieldbus/PROFIBUS PA based output |

| | | |
|---|---|---|
| 2 | Accuracy | ± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc.<br>+0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2.<br>± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc. |
| 3. | Stability | 0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer.<br>0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer.<br>0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm2. |
| 4 | Turn down | 50:1 for greater than or equal to span of 400mmwcl.<br>20:1 for span below 400mmwcl.<br>10:1 for span greater than 250 kg/cm2 |
| | (Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only). | |
| 5 | Housing | Weather proof as per IP-67, metallic housing with durable corrosion resistant coating |
| 6. | Electrical connection | ½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible |
| 7. | Process connection | ½" NPT (F) |
| 8. | Operating Ambient temperature | 85 deg C without display.<br>70 deg C with display. |
| | Overpressure | 150% of max operating pressure |
| 9 | Accessories | -Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.<br>-2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications.<br>-The valve manifold shall be non-integral type.<br>-For hazardous area, enclosure as described in NEC article 5. |

| | | |
|---|---|---|
| 10. | Mounting | 2 inch pipe mounting with Enclosure/Rack/Canopy. |
| 11. | Diagnostics & display | Self-Indicating feature and digital display on transmitter |

Notes

- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc.
- LVDT type is not acceptable.
- Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

**16.02.00 Temperature Transmitter**

**16.02.01 Single Input /Dual Input Temperature transmitter**

Temperature transmitter shall be provided which shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C.

Following specifications are applicable for dual input/single input temperature transmitter.

| S No. | Features | Essential/Minimum Requirements |
|---|---|---|
| 1. | Output | FOUNDATION fieldbus /PROFIBUS PA |
| 2. | Input | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types |
| 3. | Housing | Weather proof as per IP-67, metallic housing with durable corrosion resistant coating |
| 4. | Electrical connection | ½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible |
| 5. | Diagnostics & display | Self-Indicating feature and digital display on transmitter |
| 6. | Operating Ambient temperature | 85 deg C without display.<br>70 deg C with display. |

| | | |
|---|---|---|
| 7. | Mounting | 2 inch pipe mounting with Canopy. |
| 8. | Accessories | As required by service and operating condition. |
| 9. | Composite Accuracy | (Refer note 2 ) |

RTD =<0.25% of 0-250 deg C span

T/C-K type =<0.2% of 0-600 deg C span

CJC accuracy (for thermocouples) shall be =< 1 deg C

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.
2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed.
3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.
3. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.
4. Dual input temperature transmitters can also be accepted in place of single input TT.

**1.00.00 CONTROL DESK & PANELS**

**1.01.00 GENERAL**

1.01.01 All control desk, panels, LVS panel etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping & accessories as required for completeness of the system.

1.01.02 All panels, desks, cabinets shall be free standing type & have bottom / top entry for cables to be finalised application wise during detailed engineering stage. The bottom of desk & cabinets shall be sealed with bottom plate, compression cable glands (double for field and single for inside rooms) and fire proof sealing material to prevent ingress of dust and propagation of fire. Sufficient number of power receptacles with disconnect switches shall be installed within all panels/desk.

1.01.03 Exterior steel surface shall be sand blasted, ground smooth, filled, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. The exact color shall be finalised during detailed engineering.

1.01.04 The design shall conform to the EN ISO 11064 (Ergonomical design of control room), Part-1,2 and 3.

**2.00.00 CONTROL DESK & PANEL**

**2.01.00 GENERAL**

2.01.01 The exact dimensions, material, construction details, grounding, general arrangement etc. of Control Desk etc. shall be as per the actual requirement and shall be finalised during detailed engineering and subjected to Employer’s Approval.

2.01.02 For control desk mounted instruments/ devices etc., which are to be powered from UPS, all required conversion of interface equipments / accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like Input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS, redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.

**2.02.00 Control Desk (CD)**

2.02.01 Control desk shall be Modular, non-welded construction free standing table top type with front & back cover constructed of 1.6 mm thick CRCA steel plates. The tabletop of the control desk shall be arc-shaped for mounting TFT monitors & mice. The work surface of control desk shall be 30mm thick with the top 12mm of Acrylic Solid Surface (ASS) and the remaining 18mm of laminated medium density fiber board. Work surface shall be made of two different colors at same level and seamlessly joined in each section. The structure frame shall consist of extruded aluminum top and bottom horizontal beams and vertical support tensioned together to form an integrated, finished curvilinear shaped frame. Vertical & Horizontal supports, minimum 2.5mm and 2mm thick respectively, have to be provided for the structure frame. Extreme side legs shall be illuminated type and should complete the

overall form and aesthetics of the desk. It shall have concealed cable & wire way management system. Telephone sets shall be mounted on the control desk. Sliding keyboard trays shall be provided on the CD. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.

2.02.02 All operator monitors & mice shall be mounted on this CD.

2.02.03 The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.

**2.03.00 Internal Panel/Desk Items**

Equipment and devices mounted within the panels/desk shall be mounted on suitable racks/brackets and shall be arranged for convenient access for adjustment and maintenance work.

**2.04.00 Furniture**

Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe. Each module shall have transparent cover and adjustable partition. It shall have locking provision for security. The components shall be suitable for integration/fabrication without any welding technology.

1. Work Station furniture

   Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (inkjet or A4 laser) etc. is to be provided..

2. Server Rack

   **Server rack shall be provided to mount programmer stations, PC based systems (of rack type and tower type), Matrix KVM switcher, Mini UPS etc. Suitable arrangement for Ventillation and cooling shall be built in.**

3. PC rack

   PC rack shall be provided to mount CPUs of work stations/PCs of OWS/LVS etc in Control Room.

4. Chairs

   Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

5. Tables

a Industry standard computer tables shall be provided & shall be as approved by Employer during detailed Engineering.

6. Almirahs

Steel Almirahs shall be provided for keeping documents in the documentation room.

7. Keypad

Keypads shall be provided for the storing of keys of relevant areas in the respective control rooms

8. Lockers

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel & also for documents.

## 1.00.00 DISTRIBUTED DIGITAL CONTROL, MONITORING AND INFORMATION SYSTEM (DDCMIS)

### 1.01.00 General Requirements

1.01.01 The requirements for Distributed Digital Control Monitoring and Information System (DDCMIS) are indicated on functional basis in this specification. Contractor shall be responsible for engineering, selection and connection of all components and sub-systems to form a complete system whose performance is in accordance with functional, hardware, parametric and other requirements of this specifications. It is not the intent or purpose of this specification to specify all individual system components since the Contractor has full responsibility for engineering and furnishing of a complete system.

### 1.02.00 System Configuration

DDCMIS shall basically consist of the following:

1.02.01 Control System (including its Measurement system).

1.02.02 Human-Machine Interface and Plant Information System (HMIPIS)

1.02.03 System Programming & Documentation Facility

1.02.04 Data Communication System

1.02.05 Integrated OWS based Annunciation functions

1.02.06 Time synchronization with Master clock

The basic configuration of DDCMIS shall be as indicated in the DDCMIS configuration drawing No. 0000-151-POI-A-013.

Contract Quantities of the C&I System shall be as per Part-A.

### 1.03.00 System Expandability

1.03.01 Modular System design shall be adopted to facilitate easy system expansion. The system shall have the capability and facility for expansion through the addition of controller modules, I/O cards, peripherals like operator workstations (OWS), printers etc. The system shall have the capability to add any new control loops, groups/subgroups logics in control system.

### 1.04.00 On-Line Maintenance

1.04.01 It shall be possible to remove/replace various modules online (like I/O module, interface module etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected. Further, it shall also be possible to remove/replace any of the redundant controller module without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules etc. shall in no way jeopardize safety of plant and personnel.

### 1.05.00 Fault Diagnostics

1.05.01 The DDCMIS shall include on-line self-surveillance, monitoring and diagnostic facility so that a failure/malfunction can be diagnosed automatically and reported/indicated remotely on OWS/Programmer station. The failure/ malfunctions to be reported shall include:

(a) Module level faults of control system.

(b) Failure of HMIPIS bus/unit LAN, system bus, Local/Remote comm. Bus.

(c) Power supply faults (Over voltage, under voltage, loss of input) for each feeder of power supply for system / marshalling/ relay and HMIPIS cabinets.

(d) Software faults.

These faults shall typically be reported as color change on system status display and messages on programmer station/ OWS as well as through local indication. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place. Failure of any I/O modules, Controller etc. shall be annunciated to OWS. For I/O modules, these alarms shall be grouped, while for controller, comm. controller, power supply, these shall be individual. In case the faults are not acknowledged / rectified within certain interval, then the same shall be reported to predefined users through messaging system described subsequently in this subsection. The exact strategy of the messaging system shall be elaborated and finalised during detailed engineering.

HMIPIS shall include on-line self surveillance, monitoring and diagnostic facility so that a failure/malfunction in any of the nodes, networking device as well as communication medium can be diagnosed on the programmer/engg. Work station/OWS.

1.06.00 **Fault Tolerance & Controllability**

1.06.01 The DDCMIS shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardised. Control System shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuits/short circuits, instrument air supply failure etc. On any of these failures the control system output shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalised during detailed engineering. System shall be designed such that there will be no upset when Power is restored.

1.06.02 I/O modules shall have protection so that any fault in sensor & its wiring upto I/O module like open/short circuit, earth fault affects only that channel of I/O module. Other channels of that I/O module or other modules or other parts of system shall not be affected in any way.

1.06.03 No single failure either of equipment or power source shall be capable of rendering any part/system/sub-system of DDCMIS inoperative to any degree. No single failure in HMIPIS shall lead to non-availability of more than one OWS. In such an event i.e., single failure leading to non-availability of any OWS, it shall be possible to operate the entire plant in all regimes of operation including emergency conditions from each of the other available OWS.

1.06.04 In order to achieve above, following shall be redundant with automatic change-over (including the associated software), as a minimum:

- Controller, Comm. Controllers, HMIPIS bus/Unit LAN, System bus, Local/Remote communication bus.
- Power supply arrangement (feeders/modules)
- Output modules. (for which redundancy is specified in part-A-Contract quantities for DDCMIS).
- Servers/information work stations

- However, following need not be redundant:
  - I/O bus, (if it is a backplane bus & extension/joining of such backplane buses cabinet/adjacent cabinet) and input modules.

1.06.05 The system design shall ensure that no single failure, whatsoever in any part of DDCMIS result in loss of communication except communication between HMI and control system, for which loss of communication upto a maximum of five seconds is acceptable. However, during this period, the control system shall remain fully functional and this event shall not create any disturbance/malfunction whatsoever (e.g., accumulation of control commands, issue of spurious commands/signals etc.).

1.06.06 DDCMIS shall meet all requirements stipulated under other Sub-sections/sections of the specification including Sub-Section-IIIC, Part-A, (including the requirement Authorization to shipment test ATST) Quality assurance (Part B, Section VI of technical specifications) & General Technical Requirements (Part C Section VI of Technical Specifications).

1.07.00 **Signal Exchange**

All the signal exchange between various functional groups of each control systems shall be implemented through redundant system bus.

1.08.00 **System Spare Capacity**

1.08.01 For Control system spare capacity, refer Control System Spare Capacity as mentioned in Part A, Section VI of technical specification.

For HMIPIS spare capacity, refer Appendix-I to part A, Section VI of technical specification.

1.08.02 NOT USED.

1.08.03 NOT USED.

1.08.04 NOT USED

1.09.00 NOT USED.

1.10.00 NOT USED.

1.11.00 DDCMIS shall meet system performance and parametric requirements as stipulated under Part-A, Section-VI of specifications.

## 2.00.00 SYSTEM DESCRIPTION

2.01.00 The DDCMIS shall include following main constituents. (Also refer DDCMIS configuration drg.no. 0000-151-POI-A-013). The DDCMIS shall work in full integration and conjunction with field equipment/drives like pumps, motors, valves, actuators, dampers, hydraulic control systems and field instruments.

2.02.00 **Control System**

2.02.01 The Control system along with its measurement system shall perform functions of closed loop control, sequence control, interlock & protection of the Plant and auxiliaries in all regimes of its operation.

2.02.02 The measurement system of control system shall perform the functions of signal acquisition, conditioning and signal distribution of various types of inputs/outputs like analog, (4-20 mA DC- either from pressure / DP/ flow / level transmitters, analysers etc. as well as from temperature transmitters for all temperature) measurements from thermocouple, RTD to be connected to this system), binary, pulse, digital transmission through serial port, bus connection etc. (from remote I/O etc., Through various industry standard protect including MODBUS/FIELDBUS/PROFIBUS, prefabs freed and Ethernet etc. The inputs, which are required for only information & monitoring purposes, shall be distributed suitably in various groups plant area-wise.

2.02.03 The control system shall also perform logic & computation for annunciation functions.

2.02.04 The control system hardware (controllers, modules/cards etc.) shall be housed in cabinets located in respective control equipment room (CER) unitised and offsite except for the remote I/O cubicles (as specified in Part-A) which shall be located in respective areas.

2.03.00 **Human-Machine Interface and Plant Information System (HMIPIS)**

2.03.01 Functionality/features mentioned for HMIPIS in this specification are also applicable for unified HMIPIS. The HMIPIS shall perform control, monitoring and operation of the Plant and auxiliaries in all regimes of its operation, interacting with the Control System. For this, HMIPIS shall primarily perform following functions:

2.03.02 Operator interface for Control System

2.03.03 Plant Supervisory functions like displays, alarm monitoring & reporting, reports & logs, calculations, trend recording, historical and long term data storage & retrieval, etc.

2.04.00 **System Programming & Documentation Facility**

2.04.01 The programmer stations shall be provided for On-line configuration & tuning of Control System and On-line program development/modifications in HMIPIS.

2.04.02 A work-station based system documentation facility shall be provided to generate retrieve store & all system documentation, logic, control loops, cable interconnection, etc. to achieve paperless documentation for the complete plant.

2.05.00 **Data Communication System (DCS)**

2.05.01 The Data Communication System shall be provided for communication between Control System and HMIPIS, communication & signal exchange between various functional groups as well as communication between various units & off site / off line systems.

2.06.00 **Annunciation System**

The annunciation logic will be implemented as a part of DDCMIS and annunciation shall be made available on all OWS.

2.07.00 **Power supply:**

2.07.01 Power supply of control system shall be based on 24V DC. The Power supply along with its associated circuitry is intended to provide the following functionalities

(a) Isolation between input & output side and distribution.

(b) Multiple voltages as required by various modules as well as integration/supply voltage to field devices.

(c) Auctioneering of dual voltages.

(d) Providing stabilized/regulated power to Control System, taking care of input power supply variations.

2.07.02 The Control System shall be fed from 24V DC power supply system (please refer power supply section of specification). The complete Control System, including power supply for various modules & field interrogation, shall be through regulated power supply using power supply modules/packs. Further, the monitoring of individual feeders of input power supply shall be done as specified at clause 1.05.01 (c) of IIIC-05.

**3.00.00 MEASUREMENT FUNCTIONS OF CONTROL SYSTEM**

3.01.00 The input / output modules employed in the Control System shall be separate from controller hardware.

3.01.01 The functions listed below shall generally be performed in I/O modules. However, some of the functions can be implemented in the controllers .

3.01.02 FIELDBUS ((Foundation Fieldbus/ Profibus) Interface

For interfacing fieldbus compatible field devices/ actuators, Foundation Fieldbus/Profibus interface modules, power supply, field cables(armoured) and other accessories shall be provided. The design of fieldbus interfacing scheme, from field to Controller shall comply with all requirements of latest version of standards for Foundation Fieldbus/Profibus viz. IEC 61158. All required libraries to execute various tasks like data acquisition, control/protection etc shall be provided. Redundant host/ master card and redundant power supply along with diagnostic module shall be provided. For detailed fieldbus design guidelines, refer Annexure-IIIC-02K, Part-B, Section-VI.

The Contractor shall present complete implementation scheme, including wiring scheme during detailed engineering stage for review & approval by Employer.

3.02.00 **Analog signal conditioning & processing**

3.02.01 The conditioning and processing functions to be performed as a minimum for the analog inputs coming for control and information purposes are:

1. : Galvanic isolation of input and output signals for which power supply source is other than the measurement system of the control system.
2. : Transmitter power supply with per point fuse protection or current limiting and power supply monitoring.
3. : Monitor sensor wire break/open circuit/short circuit and take suitable actions in logic/loop. (This will include blocking of trip signals in case of RTD failure).

3.02.02 All analog signals for control purpose shall be acquired, validated, processed and their respective Controller data base updated at a maximum interval of 250 milli seconds except for some fast-acting control loops for which the above-referred time shall be as per process requirement. For signals required for information only, the above functions shall be performed at an interval of 1 seconds. The HMI database updation shall not take more than one (1) second. The validated analog inputs shall be converted into engineering units on a per point basis. Analog input processing (scanning to alarm checking) shall be performed once every scan cycle. It shall be possible to manually disable any analog input either through deleting from scan or substitution from HMI.

3.02.03 For Unit DDCMIS, the analog 4-20 mA input cards shall have input resistance >= 250 ohm inside the card/FTA (as applicable) for interfacing transmitters/analysers/temp. signals (through temp transmitters) giving 4-20mA analog signal along with superimposed HART interface signals. 4-20 mA DC signal will only be used for control purpose and superimposed HART signal will be used for configuration, maintenance, diagnostic and record keeping facility for electronic transmitters and Analysers etc

3.03.00 **Binary signal conditioning & processing**

3.03.01 The binary inputs shall be wired either in form of changeover type contacts (i.e. 'NC' + 'NO' together) or non-changeover type Contact ('NC' or 'NO') depending on the requirement, as defined in Part-A of specification.

3.03.02 The conditioning and processing functions to be performed as a minimum for the binary inputs coming for control and information purposes are:

1. : 24 VDC power supply for contact interrogation for all potential free contacts with per point fuse protection or suitable current limit feature/ isolation through opto-coupler.
2. : Contact bounce filtering. (The field contact which is changing state must remain in the new state for the filter delay time to be reported as one event). The filter delay time should be suitable for the field input & its scan rate.
3. : Facility for automatic pegging the binary signal to logic one/zero or last correct value in case of failure of binary input module.
4. : All binary signals shall be acquired validated, processed, alarm checked and their data base updated within one second.

5. : It shall be possible to manually disable any binary input either through deleting from scan or substitution from HMI.

6. : The non-coincidence monitoring shall be provided for binary inputs for all changeover signals.

3.04.00 **Multiple Measurement Scheme**

3.04.01 Triple / Dual measurement schemes shall be provided for triple / dual redundant sensors used in closed loop and open loop controls.

3.04.02 The triple / dual measurement schemes for closed loop control shall provide median / average outputs. The operator shall be able to select any of the transmitters or the median/average value from the OWS.

3.04.03 The sensors for multiple measurement schemes for open loop controls shall always be in service (except when gone Bad) and operator shall not be able to select / deselect any of the sensors. Further, measurement scheme shall be implemented considering safety / availability aspects.

3.04.04 Individual transmitter signals, their status and selected value for control/ measurement and shall be available on OWS in the CLCS displays and the popups

3.05.00 **Wiring Scheme for inputs to control system**

3.05.01 Each of the triple redundant binary & analog inputs shall be wired to separate input modules. Similarly each of the dual redundant binary & analog inputs shall be wired to separate input modules. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.

No single failure in any component of the control system shall lead to unavailability of more than one of dual/triple redundant input signals to control system. Similarly, no single failure in any component of the control system shall lead to unavailability of more than one of dual/triple redundant Output signals from the control system.

3.05.02 The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:

1. The on-off status of HT drives and synch type breakers shall be wired to two input modules in parallel.

2. Triple/dual analog sensors are required both in CLCS and OLCS for control purpose, then all of these triple/dual sensors shall be wired to the controller where CLCS loop is configured. If based on the same set of sensors, any protection action is required in OLCS (e.g., protection stop of drive) in another controller(s), then CLCS Controller shall provide three digital outputs for each such controller from three separate output modules (at defined LVM-Limit Value Monitor blocks inside Controller). The three

such digital outputs of CLCS controller shall be acquired in each of the OLCS controllers in three separate digital input modules. Similar philosophy will be used when triple/dual analog sensors are required in OLCS in multiple controllers for protection function.

3. If triple/dual/single binary sensors are required in OLCS in multiple controllers for protection function in these controllers, each of these sensors shall be shared among these controllers. Each of these sensors shall be directly shared from marshalling TBs without any 'active' multiplying hardware ('active' defined as hardware which requires a separate power supply for its functioning). Further, removal/insertion of any of such multiple modules shall not affect availability of such signal(s) to other modules.

4. The input sharing scheme shall be subject to Employer's approval during detailed engineering. The inputs/outputs for such sharing is already included in he Contract quantities in Part-A).

3.06.00 **Remote Input output modules and cubicles**

It is envisaged to use remote I/O modules in various plant areas. The remote I/O signals shall be connected to the respective functional groups through redundant extended I/O bus as indicated in the Contract quantities for DDCMIS. The hardware independence of functional groups mentioned elsewhere in specification shall be applicable for remote I/O as well.

The remote input/output modules shall be located in cubicles in respective areas. Remote input/output modules may be located in harsh environment, the modules shall be designed in such a way to work continuously under the harsh environment expected to be encountered in these areas (high temp, dust level, humidity etc.). It shall be ensured that extending of I/O bus of functional group in field does not result in false signaling /noise pickups. Further, it shall in no way deteriorate the performance of that functional group and Control System.

3.06.01 Power supply arrangement for these cubicles shall be similar to DDCMIS system cabinets.

3.07.00 The maximum number of inputs/outputs to be connected to each type of module shall be as follows:

| | | | |
|---|---|---|---|
| 1 | : | Analog input module | 16 |
| 2 | : | Analog output module | 16 |
| 3 | : | Binary input module | 32 |
| 4 | : | Binary output module | 32 |
| 5 | : | Analog input & output (combined) module | 16 |
| 6 | : | Binary input and output (combined) module | 32 |

Note: For binary inputs, one changeover contact is counted as 2 inputs.

3.08.00 The following requirements shall be met for analog/binary input/output modules as applicable.

3.08.01 Input filters to attenuate noise shall be provided.

3.08.02 All analog outputs shall be short circuit proof.

3.09.00 The Control Desk mounted hardwired devices & stations shall be interfaced through the I/O modules. No signal multiplication shall be done at marshalling end input termination end.

**4.00.00 CONTROL SYSTEM REQUIREMENTS**

4.01.00 The control system shall be broadly divided into the followings:-

4.01.01 (i) Close Loop Control System (CLCS) - Modulating control functions for various applications including individual control and operation of modulating drives.

(ii) Open Loop Control System (OLCS) - Binary control functions pertaining to sequence / interlock / protection of plant auxiliaries for various applications including individual control and operation of binary drives.

(iii) Other functions as per various requirements specified in Part-A of specification.

(iv) Performing logic & computation for annunciation functions & other miscellaneous Controls, signal processing etc.

4.01.02 The number of Functional Groups (FGs) which are derived from the above mentioned guideline are the minimum required. For each of the FGs, separate sets of controllers, I/O modules, communication controllers, power packs/ modules etc. shall be provided. Mixing of hardware of two or more FGs shall not be acceptable. However, splitting of any functional group in more than one FGs due to any limitation in Contractor's system (e.g. limitation in handling number of inputs/outputs including spare capacity, limitation in implementation of number of functional blocks including spare blocks etc.) shall be acceptable, subject to Employer's approval. It may be noted that after splitting of the functional groups, each FG must have its own set of controllers, I/O modules, etc. It shall be ensured that failure of any set(s) of hardware of any FG does not affect other FG(s) and data communication between other FG(s) and HMIPIS. Each FG can have one or more set of controllers, if supported by standard design of the offered system.

4.01.03 The Contractor shall provide all hardware/software, whether or not specifically indicated in this specification to fully meet operational/maintenance/ safety requirement as well as statutory/international standard and proven practices.

4.01.04 The Control System shall function reliably under the environmental conditions as specified in Sub-Section:- Basic Design Criteria of this specification. It shall be immune from the interference resulting from disturbances in power supply feeders, signals lines, inputs, outputs etc. as experienced in a coal fired power station. It shall be able to withstand power line disturbances.

4.01.05 The Control System shall have on-line simulation & testing facility.

4.01.06 The system shall have the flexibility to easily reconfigure any controller at any time without requiring additional hardware or system wiring changes and without disabling other devices from their normal operation mode. Modifications shall not require switching off power to any part of the system.

4.01.07 Power supply to individual functional group shall be from redundant 24V feeders with diode auctioneering and further sub-distribution.

4.01.08 The assignment of I/O channels for Inputs/Outputs, arrangement of modules within cabinet etc. shall be identical for all units except those inputs/outputs which are common for all units. Further uniformity should be maintained for redundant stream of process equipment within a unit.

4.01.09 The application programs for the functional controllers shall be software based which shall be maintained even through power supply failure.

4.01.10 Independent and dedicated controllers (main and its 100% standby) shall be provided for each of the functional group (FG) of Control System except for the cases where triple redundant controllers are to be used as per this specifications. All the 100% hot redundant backup controllers shall be identical in hardware and software implementation to their corresponding main controllers and shall be able to perform all its tasks. The backup controller shall track its corresponding main controller. There shall be an automatic and bumpless switchover from the main controller to its corresponding backup controller in case of main controller failure and vice versa without resulting in any change in control status. In case of switchover from main controller to the 100% hot backup controller, the back-up controller shall work as the main controller. Further, when only one controller is working and other controller is inserted on line (for example after repair/replacement), there should not be any degradation in the function of the working controller & control operation.

4.01.11 The loop/logic reaction time (from change of input to input module to the corresponding control command output) shall be suitable to match actual process requirements, subject to minimum requirement wherever specified.

4.02.00 **Binary Controls/Open Loop Control System (OLCS) Functions**

4.02.01 These clauses are applicable for all the Binary controls of DDCMIS included in Contractor's Scope.

4.02.02 The OLCS shall include sequence control, interlock & protection for various plant auxiliaries/valves/dampers/drives etc. The sequence control shall provide safe and automatic startup and shutdown of plant and of plant items associated with a plant group. The interlock and protection system shall ensure safe operation of plant/plant items at all times and shall automatically shut down plant/plant items when unsafe conditions arise.

4.02.03 The OLCS shall be arranged in the hierarchical control structure consisting of unit level, group level, subgroup level & drive level (as applicable).

4.02.04 The group level shall control a set of functional sub-groups of drives. Appropriate start-up and shut down commands shall be issued to the sub-group control and various check-backs shall be received from sub-groups or drives. Each sub-group shall execute the sequential

start-up and shut down programs of a set of inter-related drives along with system interlocks and protections associated with that sub-group as well as basic interlocks and protections related to individual drive falling under that sub-group. The drive level shall accept commands from the sub-groups, push buttons (wherever provided), etc., and transmit them to the respective drive, after taking into account various per missives and protections of that particular drive. For HT and other critical drives, first-up logic shall be incorporated to indicate the cause of protection/trip.

4.02.05 **Sequence Control**

(a.) A sequence shall be used to move a set of groups, sub-groups from an initial steady state (for instance 'OFF') to a final steady state (for instance 'ON'). The sequence initiating command for the unit & group level shall be issued from OWS.

(b.) A sequence shall be made of steps. The steps shall be executed in predetermined order according to logic criteria and monitoring time consisting of the interlock & protection requirements and check back of previous step which shall act as preconditions before the sequence control can execute the command for that step.

(c.) Each step shall have a "waiting time" implying that the subsequent step would not be executed unless the specified time elapses. A monitoring time shall also be defined as the maximum time required in executing the commands of any step and the time required for appearance of check back signals. In case, this is not completed within the specified time, a message shall be displayed and program will not proceed further.

(d.) Manual intervention shall be possible at any stage of operation and the sequence control shall be able to continue at the correct point in the program on return to automatic control. Protection commands shall have priority over manual commands, and manual commands shall prevail over auto commands.

(e.) Open or close priority shall be selectable for each drive.

(f.) The sequence startup mode shall be of the following types.

i) Automatic Mode

ii) Semi-Automatic Mode

iii) Operator Guide Mode/Test Mode

4.02.06 For the drives, the command shall be provided through O/P module to the coupling relays in MCC/SWGR/Actuator/Relay Cabinets as applicable and inputs (status, SWGR & process) shall be acquired through input modules. Redundancy in drive outputs shall be provided for drives, as quantified in Part-A). The failure of one of the redundant, output module shall in no way affect the function of the other output module, wherever redundancy is provided.

4.02.07 The output modules shall have the feature that ensures that in case of failure, all the outputs are driven to zero. The 24V DC command outputs to drives for ON/OPEN, OFF/CLOSE shall be separate and independent and inverted outputs shall not be employed. Live +24V DC outputs shall be provided to MCC/SWGR/ actuator as applicable when command is to be issued. Keeping +24V DC extended to the relays for these outputs continuously & extending

ground/negative when command is to be issued, is not acceptable except some of the auxiliary plants as to be decided during detailed Engineering.

4.02.08 For inching type of drives, position transmitter power supply and monitoring of position transmitter signal shall be provided.

4.02.09 The sequence interlock & protection requirements shall be finalised during detailed engineering and the same shall be subject to Employer's approval.

4.02.10 The drive function i.e. basic interlock & protection logic of the drive shall be implemented in redundant controllers. The drive function shall ensure that protection signals for the safety of the drive shall be effective under all conditions and under all modes of operation. The different commands shall be performed according to the priority of protection 'Off', Protection 'On', manual and automatic. The standard functions like running time monitoring, status signaling, alarm/drive annunciation, etc. shall be performed in drive function. The drive function shall prevent hunting of the actuator in the presence of both open & close commands for actuators of the valves & dampers. The drive function shall be implemented in dedicated standard software functional block (drive macros).

4.02.11 It shall be possible to control all common system drives (i.e. common for more than one units), from all or some of the units.

4.03.00 **Modulating Controls/Closed Loop Control System (CLCS) Functions**

4.03.01 This Clause is applicable for all analog controls of DDCMIS.

4.03.02 The CLCS shall continuously act on valves, dampers or other mechanical modulating devices such as hydraulic couplings etc., which alter the plant operation conditions. The system shall be designed to give stable control action in steady state condition and for load changes in step/ramp over the load range of 60% to 100% MCR. The system shall have the following minimum features :

4.03.03 The controller capability shall, as a minimum, include (i) P, PI, PD and PID control functions and their variations (ii) cascade control (iii) feed forward control (iv) On-Off control, (v) Ratio and bias control, (vi) Logical operation. Other advanced control strategy like adaptive & predictive control etc. can be considered for important loops like Furnace Draft, combustion control, FW flow control etc. in addition to SH/RH temperature control.

4.03.04 The control loop shall have enough flexibility and various features to perform feed forward, balancing of controller, increasing the response to achieve the desired process parameter within prescribed time frame.

4.03.05 The control system shall be bumplessly transferred to manual on the conditions of Control power supply failure, Failure of redundant controllers, Field input signal not available, Analog input and / or deviation exceeding preset value, etc. as a minimum and as finalised during detailed engineering.

4.03.06 Any switch over from auto to manual, manual to auto and switchover from OWS operation to H/A station operation and vice versa shall be bumpless and without resulting in any change

in the plant regulations and the same shall be reported to the operator and recorded automatically.

4.03.07 Analog output (positioning signal) of 4-20mADC shall be provided from CLCS to the respective microprocessor based positioner E/P converters / electrical actuators as applicable. Redundancy in drive outputs shall be provided for drives as quantified in Part-A. The failure of one of the redundant, output module shall in no way affect the function of the other output module, wherever redundancy is provided. CLCS shall also provide all the necessary outputs for indicators and other devices as specified in Part-A with output loop resistance of 500 ohms for each channel of the output module.

4.03.08 The System being supplied shall be such that when permissible limits are exceeded, an automatic switchover from an operation governed by maximum efficiency, to an operation governed by safety and availability is affected.

4.03.09 For safety reasons, switchover logics associated with the modulating control loops shall be performed within the same controller. Modulating control loops shall be provided with standard features to interface overriding commands from OLCS/SG/TG Protection System like open, protection open etc.

4.03.10 All controllers shall be freely configurable with respect to requisite control algorithms.

## 5.00.00 HUMAN-MACHINE INTERFACE AND PLANT INFORMATION SYSTEM (HMIPIS) REQUIREMENTS

### 5.01.00 Operator interface to the Control System

5.01.01 The following functions shall be provided as a minimum:

All OWS of the HMIPIS shall be fully interchangeable i.e. all operator functions including control, monitoring and operation of any plant area or drive shall be possible from any of the OWS at any point of time without the necessity of any action like downloading of additional files.

5.01.02 Further, simultaneous operation (availability of popup window/faceplate) of multiple drives of control system shall be possible from a single display.

5.01.03 The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorised use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights which shall be as finalized by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator). The users created for a particular user level shall be specific to a DDCMIS. Hence, a user of one DDCMIS shall not be able to exercise the same privileges in other DDCMIS(s). The rights of each user shall contain two types of privileges as follows :-

a) Privileges for the DDCMIS

b) Privileges for the Operating System features.

5.01.04 Typically following user levels shall be available:

a) Operator

b) Supervisor

c) Maintenance Engineer

d) Programmer

e) Shift Incharge/Station Incharge/other Monitoring Users.

5.01.05 The system shall have functionality to configure view only privilege of any sub-system from HMI of any other sub-system. In case Cross HMI operation is applicable as per Part-A, it shall be possible to enable/disable operation of any valve or drive or area belonging to any sub-system from the HMI of any other sub-systems by a supervisory command through station LAN. Such control shall be based on a pre-engineered list and as per pre-predefined priority hierarchy. In case, cross HMI operation privilege is not available for a particular drive/area and still an operation is attempted for the drive/area then a suitable regret message should be displayed in HMI to the operator. It shall be possible to modify the list at site under Maintenance Engineers/ Administrator's right.

The Contractor shall implement all necessary logics & selection facility in Control System/HMIPIS for the same with safeguard to prevent multiple operations simultaneously. Status & other signals related to the drive and the selection by any other user shall be made available to other users.

5.02.00 The following functions shall be provided:

a) Calculations: Basic calculations like time of max./min., number of transgression of a point in a band etc. shall be provided. Same can be implemented in control system also. These calculated points shall be capable of being assigned to any functions like any other scanned point.

b) Displays such as mimics, bar chart displays, X-t plots with various update rates using the data from historian, X-Y plots (with superimposed operating curves).

c) Control related displays like faceplates for different types of drives, sequence displays, drive level displays (pop-ups giving details of auto/ protection/ permissive condition/ faults), control type display (giving details of A/M selection, tagout / maintenance mode, process value, set point, deviation, command output, position feedback etc). Further, CLCS displays giving the single line diagram of the control loop shall be provided.

d) System status displays: This will provide an indication of the faults in a graphical form.

5.02.01 **OWS Annunciation Display**

The OWS annunciation will replicate in software the salient features of conventional hardware annunciations facia (for permanent viewing i.e., not operator changeable) while presenting more flexibility. This annunciation shall include both the process alarms as well as system alarms. The top area of the OWS (around 20-25%), shall be reserved for these display.

The annunciation system shall be implemented as an in-built function of DDCMIS. The field contacts shall be acquired through DDCMIS only. The annunciation points will be presented on topmost area of mimics display. The annunciation area will be divided in three (3) “alarm bands”. The annunciation sequence shall be as discussed and finalized during detailed engineering.

Bidder shall implement the annunciation functionality as described below as a minimum.

There will be one alarm for each alarm window. Grouped alarms shall be provided only for pre-defined system / field faults like non-coincidence, monitoring etc. The alarm text is to be displayed only when that alarm is present. A “tool-tip” will be associated with each alarm window, which will show tag no. of alarm point when cursor is brought over alarm window.

Hooters/Speakers of different audio types shall be available for reporting new alarms and resetting of alarms (corresponding to slow flash) etc shall be available. All flashing windows shall flash together (synchronized) in any screen. Suitable means shall be provided to distinguish new alarms and return to normal messages.

Annunciation points shall be distributed on various stations based on process area. That is, each annunciation point will be assigned screen no.(s) and an alarm band no. A particular point can be assigned more than one station also.

No fixed space will be reserved for any alarm on any of the band. Once a particular alarm band is full, the new alarm in that band will be reported by automatic shifting of the older alarm(s) on left side of band one by one in FIFO fashion. Scroll buttons shall be provided on both the sides to view the alarms in a particular band after the particular band is full.

The scroll button will fast flash when scrolled alarms are fast flashing, will slow flash when alarms are slow flashing and will be steady when alarms are steady. When scrolled alarms are of mixed type, the scroll bar will flash with highest flashing rate of scrolled alarms.

When operator right clicks on alarm area, he will get a menu with following options (i) acknowledge all- to acknowledge all new alarm(s) (ii) reset all- to reset all alarm(s) returning to normal (iii) acknowledge point- to acknowledge the particular point in alarm (iv) reset- to reset the particular point in alarm (v) Root Cause – To link to Alarm Analysis result for that particular tag (vi) “configuration utility”- to view and edit alarm list, tag nos., etc of all points in all stations (vii) closing the annunciation display. This menu can be dragged & placed anywhere on station screen. The actions (i), (ii), (iii), (iv) and (v) can be done by operator but action (vi) & (vii) will be permitted only to Programmer. The hooter sounds will be different for each of the Unit of power plant, when there is common control room for multiple Units.

Bidder shall provide suitable “configuration utility” for viewing and modifying list of all alarms (process and system) to be displayed on all annunciation area, band color, text color, flashing color and frequency, font, etc.

5.02.02 Facility of separate individual pop-up window for 30 critical alarms (to be decided during detail engineering) over the active mimic display, in OWS is to be provided. The pop-up window should require operator intervention to close. Pop-up window of one critical alarm should not overlap with any other critical alarm pop-up. The size of the pop-up window, colour of description and size of font shall be decided during detail engineering.

5.03.00 Facility of time activated logs ( Daily & Shift logs), event activated logs ( Post trip log) shall be provided. At any point of time, log/ report can be demanded by operator. Maintenance data log shall be provided for total running timer & other maintenance related statistics. This shall also include standby running hours.

5.04.00 **Historical storage and retrieval system (HSRS)**

Complete HSRS functionality shall be implemented in server/information work station (Please refer Part-A for redundancy requirements). The data shall be saved online on hard disk and transferred to the portable storage device like DVD periodically for long term storage. Provision shall be made to notify the operator when the portable disk is required to be replaced with a fresh disk. The Hard disk capacity shall be sufficient to store at least One(1) year data Suitable facility for retrieval of data shall also be provided.

The data to be stored in the above system shall include alarm and event list, periodic plant data (tags computed in control system as well as computed in HMIPIS) including data required for Residual life assessment, logs/reports etc. The data/information to be stored & frequency of storage and retrieval shall be as finalized during detailed engineering.

**6.00.00 PROGRAMMER'S STATION (PROGRAM DEVELOPMENT/ MODIFICATION, SYSTEM MAINTENANCE AND DOCUMENTATION FACILITY)**

6.01.01 The structuring/configuration/modification of Control loops/logics in Control system and program development/modification in HMIPIS shall be possible from fully graphic displays using familiar & conventional functional blocks.

6.01.02 Any modification done in Control System and HMIPIS shall be suitably logged so that it can be traced to the user log-in ID and time of change.

6.02.00 **Control system structuring/configuration/tuning facilities**

6.02.01 Structuring/configuring and tuning facilities shall be provided for structuring/ modification, storing/loading, testing, tuning, monitoring, etc. of all the microprocessor-based controllers of the control system.

6.02.02 It shall be possible to configure the system with ease without any special knowledge of programming or high level languages.

6.02.03 On-line tuning of the control loops shall be possible without causing any disturbance in the execution of the control loops. Provision to store and retrieve on immediate and long term basis the system configuration, data base etc. on some device such as floppy disk shall be included. Facility shall be provided to reload/down-load the system or controller module from the already stored data, on-line.

6.02.04 Facility for modification shall be user-friendly. For example, modification of logics/loops etc., zooming for better display, stretching etc. should be possible. It shall be possible to add/modify, delete blocks in logics/loops on-line

6.03.00 **System Documentation Facility**

6.03.01 The system shall have the facility to generate the associated documentation for both the Control System & HMIPIS with all required software and hardware tools for viewing and printing drawings and documents..

**7.00.00 DATA COMMUNICATION SYSTEM (DCS)**

7.01.00 The Data Communication System shall include a redundant System Bus for major subsystems with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non-redundant. The system shall have the following minimum features:

7.01.01 Redundant communication controllers shall be provided to handle the communication between each functional group of controllers of Control System and the System Bus.

7.01.02 Failure of one bus and changeover to the standby system bus shall be automatic and completely bumpless.

7.01.03 The following buses shall be fiber-optic only.

(a) System bus from locally mounted control system cabinets/OWS to central location.

(b) I/O Bus from remote I/Os to centrally located system cabinets.

7.01.04 The redundant buses shall be physically separate and shall be routed separately.

## 8.00.00 POWER SUPPLY, GROUNDING, CABINET/PANELS, ETC.

### 8.01.01 Power Supply

8.01.02 Contractor shall provide totally reliable & quality power supply for DDCMIS.

8.01.03 Wherever hot backup or redundant equipment likes controllers, processors, I/O modules, etc. have been specified and provided, the same shall be powered through separate power supply feeders.

### 8.02.00 Grounding

All panels, desks, cabinets shall be provided with a continuous bare copper ground bus, bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels.

Further, for connection of shields of the field instrumentation cables, a separate shield bus independent of the ground bus shall be provided, which shall be connected to the earth risers by means of independent cables.

### 8.03.00 System Cabinets/Panels

8.03.01 All DDCMIS system modules, power supply components, other control devices (except field mounted sensors/transmitters) which are required for completeness of the system shall be housed in cabinets furnished by the Contractor. All equipment and dedicated cabinets required for termination, marshalling and proper interface within Contractor’s system and also with other systems shall also be provided by the Contractor.

8.03.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Employer approved drawings in the

manufacturing works of a qualified manufacturer prior to shipment to the project site. The Contractor shall ensure that the cabinets are complete and ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets should only involve connections through multi pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/UCP.

8.03.03 The DDCMIS cabinets shall be grouped into physically separate cabinets as follows:

(a.) Control System Cabinets

(b.) Marshalling cabinets

(c.) Relay cabinets

(d.) HMIPIS cabinets

However, in case Bidder’s system design requires the termination cabinet independent from system cabinet, the marshalling cabinets can be combined with the termination cabinet. In case, the termination arrangement is part of the system cabinet, independent marshalling cabinets shall be provided. The HMIPIS cabinets can be clubbed with Control System Cabinets for small areas where only 24V dc power supply is used.

Contractor may make a special note that termination of field cables directly to control system cabinet is not acceptable.

8.03.04 Hardware like network components, power supply distribution etc. shall be suitably housed in cabinets/enclosures. In network cabinets suitable arrangements shall be provided to ensure that the network components are visible in door closed condition (e.g. Glass doors etc), as approved by Employer

8.03.05 Relay cabinets (or marshalling / termination cabinet cum relay cabinets, as the case may be) shall house all the interfacing relays in the system.

8.03.06 **Marshalling**

All the incoming / outgoing signals shall be grouped as per their origin / destination and will be terminated in the marshalling cabinets (or marshalling cum termination cabinet as the case may be). The grouping of these signals shall be subject to Employer's approval. The Contractor may make a special note that termination of field cables directly to the system cabinet (whether on TBs or on the pins on I/O modules) is not at all acceptable.

System cabinet(s) and corresponding marshalling and termination cabinet(s) shall be a single shipping section, so that the internal wiring from field terminal to the module is done completely at the factory itself.

The system cabinets shall be furnished with side panels even within a shipping section.

8.03.07 Contractor shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland

plate. In case, glanding is not possible Contractor shall indicate in his proposal his suggested procedure for cable entry and securing the cable at place.

8.03.08 The type of termination and terminal blocks to be used in the relay cum termination/ Field Termination cabinets shall be as per requirements specified under Sub-Section-Inst. Cable. The terminals used for terminating the spare cores/ pairs of field cables shall not be employed for terminating the spare channels of I/O modules/ FTMs. The following are the guidelines for termination:

a. 8 level cage clamp type of termination block shall be used in marshalling/ termination panel

b. Minimum 4 pair Instrumentation Cables shall be used for connection between field/JB and DDCMIS marshalling cabinet and all the cores of 4 pairs or its multiples to be terminated in the marshalling panel (including spare cores) sequentially as per color coding philosophy indicated in the corresponding Tender Drawing. When more than 4 pair cable is used, the same is to be terminated in consecutive marshalling posts. No core/ bundle shall be left un terminated in the marshalling panel.

c. In MFT and Turbine protection and governing system, Contractor’s standard and proven practice for cable type and cable termination scheme shall also be acceptable.

8.03.09 The protection class of cabinets and environmental rating shall be as defined in Basic Design Criteria. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. Temperature rise inside cabinet shall not be more than 10 deg C with respect to ambient temperature in any condition. Dual blowers/fan with blower/fan failure alarm shall be provided in each cabinet with proper enclosure. Suitable louvers with wire mesh shall be provided on the cabinet. Contractor shall furnish detailed calculation of heat dissipation of various components housed in the cabinet like power supply, controller, I/O cards etc., cooling fans/ blower capacity and component density in cabinets, during detailed engineering to ensure that temperature rise is limited as specified above. Further, temperature sensor (RTD) shall be provided in each system cabinet to monitor temperature inside cabinet and suitable alarms shall be configured to indicate high temperature inside the cabinet.

8.03.10 The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.

8.03.11 Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is 600 mm or above, double doors shall be provided.

8.03.12 Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish color shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. As an alternative, single

coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.

The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory applied painted surface of each item of equipment.

The finish colors for exterior and interior surfaces shall conform to following shades:

Front & Rear-RAL 9002; End panel side- RAL 5012. Internal color shall be same as external color.

Paint films which show sags, checks or other imperfections shall not be acceptable.

8.03.13 Cabinets shall be designed for a grounded installation on the building structure. Any isolation from the building ground which is required by equipment design shall be provided internal to the cabinet.

8.03.14 All alarm contacts located within cabinets as well as inputs/outputs from other related system shall be suitably terminated in the cabinets.

8.03.15 The Contractor may submit details of his standard wiring practice for similar application for consideration and approval of Employer.

8.04.00 **Relays**

8.04.01 All the relays provided by Contractor shall be suitable for control supply of 24V DC. Each relay shall have 2 changeover type contacts & the rating of contacts shall be 5 Amp at 240V AC & 0.2A at 220V DC. The VA burden of relays shall be suitable to match the capacity of output modules (however, it shall not be more than 2.5 VA). Each relay shall be provided with a freewheeling diode. The relays shall be mounted in relay cabinets except for cases where number of relays is vey less . In the cases where the number of relays is very less, the same can be mounted in termination / marshalling cabinets. All the contacts of relays shall be wired upto the cabinet terminal blocks.

## 9.00.00 SYSTEM SOFTWARE REQUIREMENTS

9.01.00 The Contractor shall provide all licensed software packages required by the system for meeting the intent, functional and parametric and performance requirements of the specification.

9.02.00 All licenses shall be valid for the continuous service life of the plant. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific, except the operating system licenses, in the event of non-machine specific license not being supported by the operating system supplier. Necessary documentary evidence to establish the same shall be submitted by the DDCMIS supplier

9.03.00 As a customer support, the Contractor shall periodically inform and upgrade the Anti-Virus / IPS/IDS software of the workstations/servers/switches/firewall till completion of the warranty period.

9.04.00 DDCMIS supplier to qualify operating system patches/ service packs and software patches of other third party software (like Office, Adobe etc as applicable, except antivirus and IPS/IDS) for use on its system during the continuous service life of the plant, subject to availability of the same by the manufacturer of the software.

9.05.00 DDCMIS supplier should periodically inform and provide software patches for all DDCMIS software till continuous service life of the plant.

**10.00.00 SYSTEM DOCUMENTATION**

The Contractor shall furnish detailed system and equipment documentation. It shall include detailed system and components description covering the installation, operation, care and maintenance of all system components. All final system documentation for DDCMIS hardware and related software shall be furnished. The same shall be complete, accurate and fully representative of the supplied system and its elements. All documentation/catalogues etc., shall be furnished in English language. In addition to the hard copies, CD ROM based documentation system shall also be provided. The same should be compatible to the On-line document generation facility indicated above.

10.01.00 **Hardware documentation**

10.01.01 Detailed technical literature, reference manuals, user's guide/manuals for the complete hardware like control system hardware, HMIPIS hardware, I/O hardware, bulk memory units, peripherals and their controllers, communication hardware including controllers, man-machine interfaces programmers unit, power supply modules etc., shall be furnished by the Bidder.

10.01.02 **Operation and Maintenance manuals**

The operation and maintenance manuals shall include all information required for trouble shooting, repair and maintenance information regarding all equipments furnished for the completeness of the system. For details refer Part-C, General Technical Requirements.

10.02.00 **Software Documentation And Software Listings**

10.02.01 All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the DDCMIS shall be furnished. The Bidder shall furnish a comprehensive list of all system/application software documentation after system finalisation for Employer's review and approval.

10.02.02 The software listings shall be submitted by the Bidder for source code of project specific application software and all special-to-project data files

**11.00.00 NOT USED**

**12.00.00 WARRANTY**

12.01.00 The Bidder shall provide an unlimited warranty on all equipment and software during the Defect liability period. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost to Employer.

12.02.00 NOT USED.

12.03.00 The Bidder shall provide warranty spares and an exhaustive list of warranty spares including components for system hardware and instrumentation and peripherals based on (and keeping adequate margin over) normally experienced failure rate shall be submitted by the Bidder for Employer's review regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the Bidder along with the main equipment consignment. The Bidder shall also provide expandable items for the warranty period. This shall include printer ribbon, ink/tonner cartridge print head etc. Excluding floppy disk, M.O. Disk, tape cartridge and paper. Unused spare/consumable shall be contractor’s property and taken back.

12.04.00 In case of any hardware failure which hampers normal operation, the Bidder during the warranty period must provide on-site technical expertise to repair/rectify the problem within a week and if any component is not available at site, the Bidder must arrange to supply these components at site within additional 48 hours. If a software problem is identified, this problem shall be corrected within two weeks.

12.05.00 After six months of DDCMIS operation the Bidder shall provide the list of parts and expendables utilized for the period. The same information will be provided at the conclusion of the warranty.

12.06.00 In order to discharge the warranty responsibility, the bidder shall include in his proposal lumpsum price for the provisions of a team of service personnel at Site who will be fully qualified to perform the required duties throughout the warranty period of one year. The Bidder shall deploy at least one engineer, one supervisor and two technicians in the team. The Employer shall approve the exact nos. & composition of team members. In case, the team is unable to rectify hardware or software problems, the Bidder shall depute and/or station additional specialist to rectify the problem to ensure 99.7% availability of system. The availability of system shall be calculated as per Sub-section-IV, Part-A, Section-VI of specifications.

**13.00.00 ANNUAL MAINTENANCE CONTRACT (AMC)**

13.01.00 The Bidder shall provide maintenance services of complete DDCMIS System under a comprehensive Annual Maintenance Contract (AMC) for period of Three years after Warranty period.

13.02.00 The AMC shall cover total maintenance of all hardware & software coming under the scope of DDCMIS and shall include free repair/replacement of all cards/ modules/ peripherals/ cables/ components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMC. For that purpose, contractor may maintain adequate no. of staff at site as per his own assessment if considered necessary to ensure availability.

13.03.00 Further, Bidder may note that during the AMC he will be allowed to use Employer's mandatory spares and has to replenish the same within three months time or before completion of AMC period whichever is earlier. However, if in the opinion of the Bidder, more

spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same.

13.04.00 The Bidder shall prepare detailed list of faults corrected and parts, expendables utilised during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Bidder's personnel.

**14.00.00 REMOTE SERVICE CENTRE**

Bidder shall provide the necessary hardware & software required for connecting the DDCMIS system to Bidder's remote service centre, through which the diagnostics & fault analysis of the DDCMIS system can be carried out. This shall include the control system and HMI, however the diagnostic of bought out items like LAN switches, etc are excluded. The method of connection shall be as per Bidder's standard practice. However, it is preferred to have the connection through a single point in the FGD DDCMIS system. The fixed charges & running cost till warranty period shall be included in the Quoted Price. The running cost thereafter shall be included in the AMC price. Connection for Remote access to the DDCMIS for diagnostics shall be through firewall. Virtual Private Networks(VPN) technology shall be used for data integrity and confidentiality. The type of VPN (SSL,IP Sec, SSL) ,no. of bits for encryption etc shall decided during detailed engineering. Further, this access shall be strictly under request control & record of such access shall be made available to the Employer’s designated personnel. Also, it should be ensured that the hardware at the other end of the Remote access connection (i.e. at the contractor’s works) shall be standalone/isolated (i.e. not connected to any network).

**15.00.00 TESTING AND COMMISSIONING TOOL**

The testing and commissioning tool is intended to be used for test operation of any drive in absence of DDCMIS during initial commissioning (e.g. fan trial run, etc.) While the tool shall be used for all type of drives envisaged in the specification, it is designed to be operated for one drive at a time. Portable trolley mounted system completed with necessary hardware for operating the drives and monitoring its parameter shall be supplied.

**1.00.00 Requirements for HMI Hardware (Refer sub section- scope of supply & services for applicability of this annexure)**

1.01.00 HMIPIS Hardware

1.01.01 All the peripherals shall conform to the following minimum requirement but the exact make & model shall be as approved by Employer during detailed engineering.

1.01.02 The Servers/Worstations/PCs/Laptop to be provided by the Contractor should be latest available in the market at the time of supply to prevent early obsolescence and shall be subject to Employer's approval. The software packages to be included with the PCs shall also be the latest version available at the time of supply.

1.01.03 The actual size of the Main and Bulk Memory shall be sufficient to meet the functional and parametric requirements as specified with 25% additional working memory and 50% additional bulk memory over and above the memory capacity required for system implementation.

1.01.04 Power Fail Auto Restart (PFAR) facility with automatic time update shall be provided.

1.01.05 For Servers and Historians / Station LAN Server/ Programming station/NMS Server the hardware shall conform to the following minimum requirements:

HARDWARE REQUIREMENTS

1. Min three no. redundant; hot swappable; Hard Disk with RAID 5 implementation. Usable Hard disk capacity shall be sufficient for the application and to store at least one (1) year historical data, wherever required.

2. Redundant Hot swappable Power supply

3. Quantity of Monitor, Keyboard and Mouse (as indicated in Part-A, appendix) has to be supplied in total for the stations placed in Programmer room of Unit Area. For all other stations Monitor Keyboard and mouse are provided as per Bidder's standard Practice.

4. One intelligent SNMP manageable mini-UPS (online) for 30 minutes backup shall be provided, with all accessories and software for remote monitoring facility, with each station.

5. Additional external graphics card with dual output ports (apart from onboard graphics card) suitable to display full HD resolution in Programmer room.

SOFTWARE REQUIREMENTS

1. Application software as per the functional requirement.

2. Anti-Virus Software with IPS#

# if anti-virus software cannot be provided as per standard practice of the DCS OEM suitable mitigating controls like whitelisting to be provided.

1.01.06 For Operator workstations/ Other workstations/ Documentation station (in case not part of prog. Stn.)

HARDWARE REQUIREMENTS

1. Standard Hardware as recommended by the Bidder shall be acceptable.

2. Individual Monitors shall be supplied for all stations (except LVS OWS)

3. Additional external graphics card with dual output ports (apart from onboard graphics card) suitable to display full HD resolution in control room.

SOFTWARE REQUIREMENTS

1. Application software as per the functional requirement.

2. Anti-Virus Software with IPS#

# if anti-virus software cannot be provided as per standard practice of the DCS OEM suitable mitigating controls like whitelisting to be provided.

1.01.07 For PC Station

HARDWARE REQUIREMENTS

1. Standard Hardware as recommended by the Contractor shall be acceptable.

2. One intelligent SNMP manageable mini-UPS (online) for 30 minutes backup shall be provided, with all accessories and software for remote monitoring facility, with each PC Station.

SOFTWARE REQUIREMENTS

1. Application software as per functional requirement

2. Latest MS OFFICE (Word, Excel, PowerPoint, Outlook)

3. Microsoft Visual Studio (only for Programmer PC)

4. Adobe Acrobat

5. Anti-Virus Software with IPS#

# if anti-virus software cannot be provided as per standard practice of the DCS OEM suitable mitigating controls like whitelisting to be provided.

1.01.08 Specification for Lap-Top (Note-Book) PC

The screen size of the laptops should be 15 – 17 inches.

All the Laptop will also be used as pluggable temporary programmer's station and operator station functionalities of the programming stations mentioned in the specifications shall be provided (including requisite license).

**1.01.09 Not used**

**1.01.10 Not used**

**1.01.11 Printers**

| Sr. No | Features | Colour Laser Printer | Colour Laser Printer | Line Impact Dot Matrix Printer |
|---|---|---|---|---|
| 1 | Paper Size | A3 | A4 | 132 column continuous fan fold type |
| 2 | Printing Speed (min.)- in normal mode for A4 size paper | 6 ppm (Color)<br>24 ppm (B&W) | 4 ppm (color)<br>16 ppm (B&W) | 1000 LPM |
| 3 | Type | Heavy duty, at least 50000 pages/month | Heavy duty, at least 30000 pages/month | Heavy duty, at least 50000 pages/month |
| 4 | Resolution (black) (min.) | 600 dpi | 600 dpi | - |
| 5 | First page out time (with full graphic display) | =<1 min for color,<br><45 sec for BW | =<1 min for color,<br><45 sec for BW | |
| 6 | Paper input capacity (min.) | 500 sheets | 500 sheets | Continuous paper feed |
| 7 | Additional features | Automatic Duplex Printing | | With printer Stand & sound proof enclosure (<60 dB) |
| 8 | Additional Cartridge/toner/ ribbon of each type as used in printer with each printer | 1 | 1 | 100 |

1.01.12 Switches :

Layer-3 switches shall have the following features:

- Minimum 15 nos. Fiber Gigabit Ethernet Port. 20% spare ports are to be provided over and above the total ports used
- 10/100/1000 Base TX ports (STP) as per requirement with 20% spare
- SNMP v1, v2, v3, RMON, VLAN, Multi link Trunk support (IEEE 802.3ad – Link Aggregation)
- Broadcast/multicast storm control
- Non-Blocking wire speed
- Hot swappable dual redundant Power Supply
- RIP, OSPF, BGP
- VRRP
- PIM and DVMRP Multicast Routing
- IPV4and IPV6 ready
- Support MACsec in hardware (IEEE 802.1AE)
- 10 GB module support for future upgradeability

Expandability/stackability through a dedicated high speed expansion port.

Routable, remotely manageable, configurable.

One intelligent SNMP manageable mini-UPS for 30 minutes backup shall be provided with all accessories and software.

Secondary switches shall have the following features:

- 10/100/1000 Base TX ports (STP) as per requirement with 20% spare
- Gigabit Ethernet Port as per requirement with 20% spare
- SNMP, RMON, VLAN, Multi link Trunk support.
- Support for stacking with high throughput
- Broadcast/multicast storm control

1.01.13 Firewall :

Firewall appliance should facilitate multi-vendor, multi-application environment and should support third-party products on open alliance. It should support Active-Active configuration.

- The firewall should contain following features:

  (a) Stateful inspection of packets.

  (b) NAT functionality, including dynamic and static NAT translations

  (c) Latest version of SNMP

- The firewall must send log information to a separate log server via an encrypted connection. Firewall logging must not impact firewall performance.

- Remote network access to the firewall should only be possible through the administration interface.

Firewall should also meet the following requirements.

- The firewall must not support any unencrypted means of access to the firewall.

- It should Monitors ALL network traffic-traffic at Firewalls (Internet and external networks), in the DMZ and detect known threat through deep packet inspection.

- Detects unknown threats via anomaly scanning.

- Detect unknown threats via behavior pattern to protect from zero day attacks.

- Keeps up-to-date on new threats and vulnerabilities.

1.01.14 IPS/ IDS Features :

In order to inspect all inbound and outbound network activity and identify suspicious patterns that may indicate a network or system attack from someone attempting to break into or compromise a system on the NTPC Station LAN Network, the IDS/IPS will be provided as per the Station LAN configuration.

1.01.15 Network Management Software (NMS) :

The network management software should contain the below mentioned features.

- Graphical user interface (GUI) management.

- Automated discovery and display of Ethernet topology and devices.

- Monitor traffic flow through the device

- View a device image indicating which ports are active and which modules are installed. It a particular network device is down, it should give the tools like ping/telnet options in the same screen to further diagnose the problem.

- Real-time activity and utilization statistics and graphical trends.

- Facility of providing pre-defined actions like e-mail, SMS etc. upon any event generated in the network.

- Facility of viewing logical graphs of devices like routers, web servers, according to the needs.
- The following parameters should be monitored.
  - Device status
  - Port Status
  - CPU utilization
  - Memory Utilization
  - All port utilization including uplink ports.

  For monitoring the parameters mentioned above, the NMS workstation should be connected to all HMIPIS switches/firewalls through management LAN which is a separate LAN from the redundant Station LAN.

**Security Policies/Procedures and Security Audits** :

In order to enforce network security in the Station LAN & the HMI of all DDCMIS, security policies and procedures are to be followed by the Contractor during the tenure of the Contract & by Employer's site personnel thereafter.

For checking compliance to the above security policies & procedures ,periodic security audit by a certified auditor (as per CERT-IN panel or CERT of country of origin of DDCMIS supplier)) is to be arranged by the Contractor during ATST, at the time of trial operation/PG test of C&I package and every year during AMC period. This shall include vulnerability assessment of the workstations/ servers and penetration testing of the Station LAN through the firewall from a node outside the network. Suitable actions based on the findings of the security audit shall be carried out by the Contractor.

These security policies/procedures envisages formation of an Information Security team which shall comprise of vendor's personnel deputed at site during tenure of the contract and NTPC personnel thereafter. All the responsibilities of information security team have to be discharged by vendor's team during tenure of the contract and NTPC team thereafter. Even though different roles have been identified for the individual members of the information security team more than one role can be performed by the same person. It may be noted that following policies/procedures are only the operation guidelines and advisory steps to ensure maximum data security.

The following security policies shall be followed. Details of the same shall be provided during detailed engg.

1. Information Security Policy
a) Information Security Team Policy
b) Firewall Policy
c) Information Identification and Classification Policy
d) Security Policy Review Policy
e) Information Labeling and Handling Policy
f) System Planning and Acceptance Policy
g) Capacity Management Policy
h) Media Handling Policy
i) Information Security Awareness Policy
j) Third Party Access Policy
k) Change Control Policy
l) Anti Virus Policy
m) System Access Policy
n) Monitoring Policy
o) Incident Handling Policy
p) Information Backup and Restoration Policy
q) Network Access Policy
r) User Access Management Policy

## 1.00.00 GENEREAL REQUIREMENTS FOR FIELDBUS INSTRUMENTS AND ACTUATORS

This section provides the basic guidelines for the design and implementation of Fieldbus (Foundation Field Bus/ Profibus) based control system.

1.01.00 The requirements given herein are minimum requirements to be considered by Contractor to ensure uniformity in basic design and shall not be considered as final requirements. The Fieldbus design shall be further validated by contractor and approved by Employer during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by contractor without any implications.

1.02.00 The fieldbus segment design shall be finalized and validated based on functional requirements as per:

- Process requirements (P&IDs/ operational requirements).
- Loop response time of different loops device communication time i.e. cycle time for fast and slow loops with scheduled and unscheduled organization as per project.
- Area classification requirements (e.g. hazardous or safe).
- Fieldbus devices specifications (maximum current drawn from bus, block execution speeds, power conditioner suitable for field barrier, etc.)
- Length of segments.
- Instrument location plans with elevation details.
- Host-system documentation showing configuration rules or restrictions.
- For Foundation Fieldbus & Profibus PA chicken foot/ branch/ or combination of both topology shall be provided. For Profibus DP, Bus/ Line topology in Redundant mode shall be provided. That is, for Profibus DP redundant cables connected to redundant ports of devices shall be provided.
  Suitable field bus segment design shall be considered keeping the safety & integrity of the system intact so that the cabling, marshalling, junction boxes and system performance shall be optimized.

However, all such segment device allocation, topology shall be decided during detailed engineering. Any modification shall be carried out by contractor without price implication.

1.03.00 Contractor to provide all standard functional blocks for all Foundation Fieldbus/ Profibus devices as per latest FF/ Profibus version and standard guidelines. Fieldbus components including power supply, terminators, isolators, etc. provided by Contractor shall comply to IEC 61158 and other standard Fieldbus guidelines.

1.04.01 Redundant host/ master card and redundant power supply along with advance diagnostic module shall be provided. All required libraries to execute various tasks like data acquisition, control/protection etc. shall be provided.

1.04.02 In fieldbus system following spare capacity in each FG shall be provided :

| Item | Sub Item | Spare capacity |
|---|---|---|
| Controller | Software Blocks | 30% |
| | Host | 30% |
| Host/ Power supply | Installed spare capacity | 10% |
| Host/ Power supply space | Only spare space | 20% |
| Segment spare capacity | | 40% |

If in a FG, conventional and fieldbus system both are implemented then above spare capacity shall be in proportion to fieldbus/ conventional system implementation.

1.04.03 The contractor shall present complete implementation scheme, including wiring scheme during detailed engineering stage for review and approval by Employer.

1.05.00 Fieldbus cable (specifically used for Foundation Fieldbus/ Profibus PA and Profibus DP) shall be Individually shielded twisted pair, with round steel wired armour (SWA) complying to IEC 61158, Type A. The cable construction shall meet EN 50288-7 standard for physical properties and the outer sheath shall be of PVC-TM53 as per EN 50290-2-22. Continuous operating temperature of Fieldbus cable shall be minimum 90 Deg C.
For laying of fieldbus cables, cable trays envisaged for instrumentation cable with all the accessories shall be used by the contractor. Minimum 300 mm spacing to be kept between the fieldbus trays and other high voltage cables to avoid any interference.
SS Junction boxes specially designed for fieldbus application shall be provided on as required basis. These SS JBs shall house field mounted fieldbus components like distributers, tee, etc. These SS JBs shall have suitable cover and gasket and shall have protection class of IP-66 or better. SS Cable glands and blind plugs shall be provided by the Contractor.

1.06.00 Comprehensive Fieldbus Maintenance and Diagnostic software shall be provided. This software shall be capable of collecting complete diagnostic information from fieldbus network and all fieldbus devices and presenting in user friendly interface for detailed diagnostic and troubleshooting of the system. It shall be possible to completely configure parameters of fieldbus network and fieldbus devices from centralized system through this software. This software shall have feature of providing data related to maintenance of

fieldbus devices as available through fieldbus system. This system/ software shall have provision to get updated to latest version/ release of various fieldbus devices.

1.07.00 During FAT suitable arrangement shall be made by Contractor to test Fieldbus modules including field devices as per approved FAT procedure.

1.08.00 The contractor shall use fieldbus segment design tool / software to design complete network verifying various design parameters like device voltage, total cable length, spur length, system power requirements etc. the contractor shall provide device voltage calculations for all segments, based on calculation in software package. All these calculations shall be handed over during detailed engineering in electronic format in a way that Employer can thoroughly verify design basis/ calculations carried out by Contractor.

1.09.00 Suitable short circuit protection, surge protection, grounding requirements shall be provided for all devices, so that fault in one device shall not impact the availability of other devices in the segment.

1.10.00 All required diagnostic and configuration tools/ hand held devices shall be provided for configuration and troubleshooting of devices and network.

## ELECTRICAL POWER SUPPLY SYSTEM

### 1.00.00 General Requirements

The requirements of Electrical Power Supply system are specified herein on system basis. The Contractor shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification including tender drawings and Employer approved drawings during detailed engineering. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipments and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures, & distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works.

The Contractor shall furnish all required equipment cubicles and wiring required for conversion and/or stabilization of the power sources provided by the Employer to all other levels which may be necessary for meeting the individual requirement of equipment/system furnished by him including the panel/desk mounted equipment.

24 V DC power supply system shall be provided as below:-

**i)** 24V DC power supply system for DDCMIS based control system shall comprise of two sets, each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller – one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.

Necessary redundant transformers shall be provided by the contractor to derive the power supply from 415V, 3 phase, 3 wire incomers for above.

### 1.01.00 POWER SUPPLY SYSTEM FOR DDCMIS BASED CONTROL PANELS

1.01.01 Microprocessor based, Intelligent, Modular Power Supply.

1.01.02 Microprocessor based, intelligent, modular power supp1y shall be sized to meet connected load requirements and keep the connected battery full charged in Float/ Boost mode. A provision of 10% design margin shall be kept over and above the load requirement. Either of the bank of rectifier modules shall be able to recharge fully discharged battery within 8 hours. It shall also be possible to discharge batteries periodically manually. Each rectifier bank shall have N+1 rectifier modules for all applications. The exact sizing of the rectifiers in one bank shall be as approved by

Employer during detailed engineering. While selecting the components and finalizing the cooling arrangements, Bidder to note that these rectifier modules are required to operate at 30-40 % of the rated load for most of the time. While sizing, the temperature derating factor as applicable, is to be considered for arriving at the rating of the modules as per Bidder's manufacturing standard if the modules are rated for lower than the 50 deg. C ambient. For the rectifier bank, matching controller along with applicable software shall be provided to meet system requirements under all modes of operation."

1.01.03 The rectifier module shall be microprocessor controlled, IGBT/Power MOSFET based, high frequency with active load sharing, designed for single and parallel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage and DC load fluctuates, effective current limiting features, front access design, programmable temperature compensation feature for battery charging and filters on both input and output to minimize harmonics. The rectifier module output regulation shall be +/- 1% or better from no load to full load with an input power supply variation of +/- 10% in voltage and +/- 5% in frequency. In addition to indications / display on rectifier panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS system. Further isolated 4-20 mA signals shall be provided for important parameters like rectifier bank voltage, rectifier bank current, battery voltage, battery current, DCDB Voltage, DCDB current etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. Necessary provision shall be done in DDCMIS end also.

1.01.04 "Float / Boost" charge functions shall be provided with alarm / indications.

1.01.05 Each rectifier bank shall be rated for 100% load requirement and keep the connected battery full charged and one spare rectifier module.

1.01.06 The rectifier module circuitry shall be of fail-safe design and failure of any component should not result in any rectifier bank output voltage to increase beyond acceptable limits of the C&I system being fed from it.

1.01.07 The rectifier module shall be current limited for circuit protection and protection of battery from overcharge. The current limit shall be continuously programmable.

1.01.08 The rectifier module shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energized.

1.01.09 The rectifier module shall be fed from 415 V AC, 50 HZ, 3 phase, 3 wire system. Bidder shall provide all required power cables & other accessories etc. from 415 V AC power supply system to his electrical power supply system.

1.01.10 The full load efficiency of rectifier module at nominal input and output shall be 90%. The ripple content shall be limited to +/- 0.5% of output voltage.

1.01.11 Bidder shall furnish the equipment complete in all respect along with rectifier module rating & voltage drop calculations, supporting curves / data etc.

1.01.12 The Controller shall be intelligent, microprocessor controlled for monitoring & control of rectifier modules with features viz. auto / manual battery discharge test, battery reserve time prediction, energy management, float / boost mode control etc.

1.01.13 All software as required for smooth operation and monitoring of rectifier modules in conjunction with controller & BHMS shall be provided by the Contractor.

1.02.00 **Batteries for DDCMIS system**

1.02.01 The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop of 2V from battery room to DCDB and DCDB to load, while sizing the battery.

1.03.00 **DC DISTRIBUTION BOARD (DCDB)**

Redundant DC feeders (one from each DCDB) shall supply each of the connected panels. From DCDB / panel to driver/load feeder shall be in scope of Bidder. The exact design, rating & number of feeders of the each redundant DCDB shall be as finalized during detailed engineering and as approved by Employer. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each DCDB.

1.04.00 **Battery Health Monitoring System (BHMS)**

BHMS, wherever applicable, shall include microprocessor based hardware and software to monitor the condition of each battery cell of 24 V DC systems on-line. With BHMS it shall be possible to measure & analyze the minimum and maximum voltage values of each battery-cell so that any damage to battery shall be prevented

by pro-active maintenance. BHMS shall communicate with the charger/DDCMIS and provide alarms as finalized by Employer during detailed engineering.

**1.05.00** The UPS Power Supply for various systems shall consist of one or more of the following configurations.

Bidder shall clearly bring out in the proposal the configuration diagram, single line diagram and datasheets etc. & this shall be finalized subject to employer's approval during detail engineering.

Configuration B :

UPS system shall consist of 1 x 100% charger and inverter with input isolation transformer, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories.

The specifications for this UPS configuration shall be as per Cl.No. 1.06.00 to 1.06.05 and specifications for Battery shall be as per Cl. No 1.06.06 for Ni-Cd type Batteries.

**Configuration C :** On line UPS with remote monitoring having a battery backup of 30 min. The batteries for UPS System shall be Sealed Maintenance Free type and shall be as per Control System Vendor's standards.

**1.06.00 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM**

The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 deg c.

The UPS system shall meet the following requirements as a minimum.

If UPS KVA rating is applicable at a lower ambient temperature than specified 50 deg.c, the bidder shall consider a derating factor of at least 1.5%/deg.c for arriving at the specified UPS capacity at 50 deg.c ambient. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The inverter shall have sufficient capability to clear fault in the maximum rated branch circuit, limited to 8 percent of finally selected ups capacity.

**1.06.01 Chargers**

**1.06.01.01** The chargers shall be self regulating, solid state silicon controlled, full-wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates,

effective current limiting features and filters to minimise harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. Furthermore the charger should be able to re-charge the fully discharged battery within 8 hours. The charger output regulation shall be ± 1% from no load to full load with an input power supply variation of ± 10% in voltage and ± 5% in frequency. In addition to indications/display on charger panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering.

**1.06.01.02** The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised.

1.06.01.03 The chargers shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration.

1.06.01.04 The minimum full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to +/- 2 % of Charger output voltage.

1.06.01.05 The UPS battery shall have sufficient amp-hour capacity to supply the steady state KVA rating of the UPS specified for 60 minute, irrespective of the actual load on UPS.

1.06.01.06 The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.

1.06.01.07 The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the other charger whose mains input power supply is healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice & continue to charge the D.C. battery at all load conditions. The Bidder should note that this situation should not in any way lead to the discharge of the D.C. Battery.

**1.06.02 Static Inverters**

The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts. single phase ,50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. The steady state voltage regulation shall be +/-2% and transient voltage regulation (on application/removal of

100% load) shall be +/-20%. Time to recover from transient to normal voltage shall not be more than 50 mSec. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination shall be better than ± 0.5% (automatically controlled). The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The inverter efficiency shall be at least 85% on full load and 80% on 50% load. The synchronisation limit for maintenance of synchronisation between the inverter and stand by AC source shall be 48-52Hz, field adjustable in steps of 1 Hz.

**1.06.03 Static Switch and Manual Bypass Switch**

The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from (i) faulty inverter to healthy inverter in case of failure of one of the two inverters and (ii) from faulty inverter to standby AC source in case of failure of both the inverters. The transfer time shall be ¼ cycle maximum in synchronous mode.

Manual bypass switch shall be employed for isolating the UPS during maintenance.

Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each inverter. Peak Capacity shall be 1000% of continuous rating for 5 cycles.

**1.06.04 Step Down Transformer and Voltage Stabiliser**

One 415V three phase to 230V, single phase transformer along with associated voltage stablizer shall be furnished with each UPS system. The transformer and stablizer combination shall convert Employer furnished 415V ± 10% three phase plant auxiliary AC supply to 230 V ± 2%, single phase standby AC Power Supply source.

The transformer shall be of low impedance air-cooled type and its KVA rating and percentage impedance should be selected so that extremely fast fault clearance is achieved.

The overload capacity of the transformer and voltage stabilizer shall not be less than 300% for 200 millisecond duration. The voltage stabilizer shall employ servo-controlled circuitry and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the stabiliser shall be 95% or better.

The type and other details shall be subject to Employer’s approval.

**1.06.05 AC Distribution Board (ACDB)**

The details of the AC distribution board, i.e. exact, rating and number of feeders etc. of the 2x100% ACDB shall be designed to cater to the requirements of Contractors systems. 25% Spare feeders of each type and rating to be provided in each ACDB.

**1.06.06** The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one

hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop from battery room to ACDB and ACDB to load, while sizing the battery.

## CONTROL AND INSTRUMENTATION SYSTEM

### 1.00.00 GENERAL

1.01.00 a) The Contractor shall provide Independent Control & Instrumentation system for control, monitoring and operation of associated drives and auxiliaries in FGD system including Limestone grinding & handling system, Gypsum Dewatering & handling system and other systems being provided under the contract, in all regimes of operation in safe and most efficient manner. The Contractor shall provide all systems, equipment, accessories and associated equipment, which are included in Contractor's scope, in a fully operational condition acceptable to the Employer.

b) The Contractor shall provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. The work shall be consistent with modern FGD based power plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract.

c) The scope of work shall also include all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipment ensuring operability, maintainability and reliability.

d) The Contractor shall also provide all the instruments along with cables, JB etc. for equipments / drives and services which may not be specifically stated in this specifications but are required for completeness of the FGD Control system shall be furnished by the Contractor and for meeting the intent and requirements of these specifications.

e) The Bidder scope shall include design, manufacture, engineering, inspection & testing at supplier's works, packing, forwarding to site, unloading, erection, testing & commissioning. The following clauses describe the brief scope of supplies. Scope shall be as described briefly in the following clauses but not limited to it. The detailed technical specifications are stipulated under Part - B, Section-VI of the specification as well as in various other Parts of the Technical Specifications.

f) In this project fieldbus(FF/Profibus) based instruments(PT/DPT/TT), Fieldbus based Non-intrusive Electrical actuators are also envisaged which shall be connected to the DDCMIS. The protocol of fieldbus (FF/Profibus) for non-intrusive electric actuators and fieldbus based instruments shall be matching with fieldbus

protocol of FGD System DDCMIS, and the same shall be subject to Employer's approval.

g) Scope defined in PART-A read in conjunction with PART-B has to be provided for each station (i.e. 11 sets for 11 stations) under LOT-1A package. The scope detailed hereunder in the following clauses is for one set.

1.02.00 In this package fieldbus based controls and conventional controls (hardwired 4-20mA/DI/DO) both are envisaged.

1.02.01 Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications. In case non fieldbus based actuator or transmitters are required for few applications then the same shall be discussed and finalized during detailed engineering.

A. For fieldbus based instruments/ actuators following guidelines shall be followed:

a. Actuators which are in main and standby line shall be wired to separate host/ master of FF/Profibus.
b. Dual/Triple redundant PT/DPT/TT shall be wired to separate segments.

B. Loop Reaction Time (time between field acquisition to field output in control system) :

a. For Fast Closed loop controls of conventional system, loop reaction time shall be 250ms or better as per process requirement.
b. For other Closed loop controls, conventional/ fieldbus based/ mixed, loop reaction time shall be 500 ms or better as per process requirement.
c. For Fast Open loop controls of conventional system (Tie/ trip selection), loop reaction time shall be 100ms or better.
d. For other Open loop controls, conventional/ fieldbus based/ mixed, loop reaction time shall be 1 Second or better as per process requirement.

The above shall be suitably demonstrated by the contractor.

C. For Foundation Fieldbus & Profibus PA chicken foot/ branch/ or combination of both topology shall be provided. For Profibus DP, Bus/ Line topology in redundant mode shall be provided. That is, for Profibus DP redundant cables connected to redundant ports of devices shall be provided.

Specific approval of Employer shall be taken before finalization of protocol of Fieldbus for DDCMIS and for the fieldbus based equipments being connected to DDCMIS like PT/DPT/TT and actuators.

Further, the grounding scheme of fieldbus system shall be as recommended by FF/ Profibus standards and Contractor shall submit the detailed scheme at the start of engineering for Employer's approval.

D. The design of control system cabinets with fieldbus components shall be finalized during detailed engineering stage and various requirements specified for DDCMIS cabinets in Part-B of this specification will not apply.

E. The actuators shall be fully compatible with the valves being provided in this package. Further, 5 Nos. configuration/ diagnostic tool (if applicable) for non-intrusive actuators and 5 nos. configuration/ diagnostic tool (if applicable) for all fieldbus compatible devices shall be provided for complete package.

F. Twisted pair with round steel wired armour (SWA), Type A fieldbus cable complying to 61158 (detailed Specification as per PART-B), SS JBs with IP-66 and accessories for fieldbus based instruments and actuators shall be provided by the contractor under this package.

## 2.00.00 DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS)

2.01.00 Latest state of the art microprocessor based Distributed Digital Control, Monitoring & Information System (DDCMIS) shall be provided comprising of the following as a minimum and meeting all requirements specified under Sub-section IIIC-02 DDCMIS of Part -B, Section-VI of Technical Specification and the following annexure of this subsection:

IIIC-02G: HMI Hardware

IIIC-02J: Security Policies and Procedures

IIIC-02K: Guidelines for Fieldbus System

The contract quantity of hardware and peripherals of HMIPIS, programming station etc. shall be as per Appendix-I to Part- A, Section-VI of Technical specification read in conjunction with detailed technical specification.

For Messaging system, wireless link and Remote Service Centre connectivity (for each type of DDCMIS) the fixed cost (e.g. service provider charges & its equipment etc.) and running cost till warranty period shall be included in the Quoted Price. The running cost thereafter shall be included in the AMC price for the total duration of AMC, i.e. three years.

### 2.02.00 Flue Gas De Sulphurization (FGD) DDCMIS

2.02.01 FGD System comprising of binary and modulating controls of complete Flue gas desulphurization system, material handling systems etc. shall be implemented in the DDCMIS separately for each project. The Control System of FGD DDCMIS has following process blocks as minimum. Any other systems apart from the below

mentioned systems shall be included in the common system. Details of control blocks with respect to process blocks shall be finalized during detailed Engineering:

FGD DDCMIS consisting of following:

(a) Unitized process blocks:

i. Unit-1 absorber and associated system
ii. Unit-2 absorber and associated system
iii Unit-3 absorber and associated system
.
.
.
n) Unit-n absorber and associated system
where n is the number of generating unit per stage

(b) Common system process blocks:

i. Gypsum De watering Handling common system block.
ii. Lime stone preparation and handling common system block.
iii. Other associated common system.

In addition to monitoring and control from the FGD control room, the systems indicated at (a) & (b) shall also be monitored and controlled from each Unit control room.

2.02.02 In order for fast, trouble-free and smooth execution and support during Operation and Maintenance period as specified elsewhere in the specification, Bidder/ Contractor/Sub-Contractor or its group of company of the offered DDCMIS system should have a well-established DDCMIS hardware and software service center in India working for at least 5 years from the date of bid opening.

2.02.04 Depending on the cable distance between FGD control room and FGD sub systems such as Gypsum handling system, Limestone handling system etc, requirement of Remote Input Output (RIO) shall be finalized during detail engineering, In such cases, contractor to provide RIO on as required basis. Contractor shall place RIO cabinets inside building with air conditioning environment. Building, Air conditioning, power supply for RIO cabinets shall be in contractor’s scope.

2.02.05 The Bidder shall provide software license for all software being used in Bidder’s System. The software licenses shall be provided for the organization i.e. it should not be site-specific and shall also not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Owner to seek a new license/renew license due to up gradation/change of hardware/machine in Bidder’s System at site. All licenses shall be valid for the continuous service life of the plant.

2.03.00 The above system(s) shall include their respective measurement system for signal acquisition, conditioning and signal distribution of various types of inputs/outputs,

meeting specification requirements including respective Hardware requirements as stipulated in Sub-section -DDCMIS, Part-B, Section-VI of Technical Specification.

The DDCMIS also envisages fieldbus (Foundation fieldbus/ Profibus) complying with IEC61158 for control and signal acquisition from fieldbus compatible actuators and instruments. Field-bus interface modules shall be provided in each FG.

**2.04.00 Human - Machine Interface & Plant Information System (HMIPIS)**

2.04.01 HMIPIS configured around latest state-of-the art servers/Workstations with open architecture supporting OPC/TCP/IP protocols, etc. shall be provided.

2.04.02 Control, operation and monitoring of FGD and associated system being provided under the contract is primarily envisaged from Contractor's OWS placed in FGD common control room. In addition to above, it is also envisaged to control, operate and monitor FGD and associated system remotely from main plant Central Control Room (CCR) using OWS placed in CCR.

The HMIPIS will include the following as a minimum:

Operator Work Station (OWS) in Central Control Room (CCR) and FGD common control room. NTPC shall provide 02 nos. of UPS power feeder per unit from employer's ACDB, for powering FGD OWS located in CCR. Cabling from ACDB to FGD OWS (located in CCR) shall be in bidder's scope of supply.

Processing Stations (Servers/Workstations) in redundant configuration including RAM, dual bulk memory etc. Removable storage Media shall be used for historical storage and retrieval and long term storage and retrieval of data.

Redundant LAN for communication between various OWS, between OWS and processing stations and OWS. A redundant station-wide LAN for connecting the unitized and common systems of FGD DDCMIS as well for connecting to Employer’s Station LAN through firewall. This shall include all cables and accessories required for connecting Contractor’s system upto the Employer’s systems such as Station LAN, etc. Alternatively, Bidder’s standard & proven solution, which is functionally equivalent to redundant system bus and single fault tolerant, shall be acceptable.

2.04.03 Adequate measures shall be provided for the security of the DDCMIS including the interface to Employer’s Station LAN as detailed at Part-B, subsection DDCMIS. This includes Redundancy in firewall, Connection to Contractor remote service center through VPN technology, etc.

2.04.04 Suitable hardware/software for interfacing of FGD DDCMIS with following systems

(i) Employer's Station LAN.

(ii) Remote diagnostic station for FGD DDCMIS at OEM end.

2.04.05 DDCMIS vendor shall upgrade/ update all DDCMIS system along with release of DDCMIS system software/ patches, meeting the system software requirements as mentioned in DDCMIS chapter, Part-B, SECTION-VI. This shall include the latest supported OS and its corresponding latest version/ release of DDCMIS system software/ patches. The upgrade/ update shall be carried out in the penultimate year of AMC (In case of one year AMC, third month from the date of commencement of AMC). Any change in hardware required for the same shall also be carried out by the contractor within the contract price.

**2.05.00 Data Communication System**

System Bus connecting Control System and HMIPIS. Other bus systems for connecting various systems/subsystems of DDCMIS like Cubicle Bus, Local Bus, I/O Bus ( Including Remote I/O Bus) soft links (including those from Field Bus based temperature transmitter) as well as within systems/sub-systems of DDCMIS. All the bus systems shall be redundant except for back plane buses which can be non-redundant.

**2.06.00 Remote Input/ Output Modules**

Remote input / output modules and cubicles for specified locations in the plant for the signals, which are used for information and Control / Interlock purpose, are to be provided.

**2.07.00 Annunciation Function**

The annunciation system shall be built as a part of the control system of the DDCMIS.

**2.08.00 System programming, diagnostics & documentation facility**

2.08.01 The programmer station shall be provided for configuration /tuning/structuring of control system and program development /modification of HMIPIS. A Workstation based system documentation facility for automatic generation of system documentation shall be provided to achieve paperless documentation for the project. The diagnostic system shall have elaborate diagnostics facility giving details of fault in I/O modules, other modules and cabinets on OWS in form of display and text messages.

2.08.02 Software for determining optimum controller settings for control loops shall be supplied as per subsection DDCMIS, Part-B, Section VI for each unit.

## 2.09.00 Power Supplies

Redundant power supply modules/packs for powering the systems described above in system cabinets with necessary auctioneering and distribution.

## 2.10.00 Cabinets

(a.) System cabinets housing electronic modules and power pack supplies of system described above.

(b.) Marshalling cabinets separate from system cabinets for terminating inputs from field, MCC/SWGR etc., for further wiring to control system and for terminating outputs from control system to MCC/SWGR etc.

In case Bidder's system design requires the termination cabinet independent from system cabinet, the marshalling cabinets can be combined with the termination cabinet. In case, the termination arrangement is part of the system cabinet, independent marshalling cabinets shall be provided.

(c.) Relay cabinet-housing relays for providing contact outputs by control system to other system wherever contacts are used in circuit/scheme of Control supply/power supply of more than 24 V and in cases where the VA burden is more than the VA burden the Output module can drive. Alternatively, these relays can also be mounted in termination/marshalling cabinets also. It may be noted that relays cannot be mounted in system cabinets.

(d.) NOT USED

(e) In case DDCMIS supplier can provide system cabinet with suitable partition to create separate marshalling area on the rear side of the system cabinet, ensuring that dust ingression does not take place in system area, the same can also be accepted subject to Employer's approval during detailed engineering stage.

(f) The design of control system cabinets with fieldbus components shall be finalized during detailed engineering stage. The contractor shall propose suitable design of these cabinets keeping in view, ease of operation and maintenance and minimizing entry of dust to cabinets for Employer's approval.

## 2.11.00 Warranty and Annual Maintenance Contract

Warranty and Annual Maintenance Contract (AMC) for DDCMIS, as per Sub-section DDCMIS, Part -B, Section-VI of Technical Specification.

**2.12.00** Representative of OEM shall also be required to be present during Factory acceptance testing (Authorization to shipment test ATST) of respective DDCMIS for testing of finally implemented control system. Logic/HMI implementation for various DDCMIS system shall be done in Uniform way and documents of these shall be furnished in uniform format, as approved by Employer.

**2.13.00 Control System Spare Capacity**

2.13.01 Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, DDCMIS shall have spare “Usable” capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:

2.13.02 10 % spare channel shall be provided in each functional groups for each type of input / output fully wired up to the marshalling/ termination TBs.

2.13.03 Wired-in "usable" space for 20% modules along with Field Terminal assemblies, PCB/Connectors (if any in the offered system) in each of the system cabinets for mounting electronic modules shall be provided by the Contractor for future use.

2.13.04 Each controller shall have 20% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type mentioned in clause 2.13.02 & 2.13.03 above, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of controller.

2.13.05 Ten (10) percent spare relays of each type and rating, mounted and wired in relay cabinets. All contacts of relays shall be terminated in terminal blocks of relay cabinets. In each of the relay cabinets, 10 % spare terminal blocks shall be provided so that additional relays can be mounted and wired.

2.13.06 Twenty (20) percent spare terminal blocks in each marshalling cabinets.

2.13.07 The spare capacity as specified above shall be uniformly distributed throughout all functional groups. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers/ cabinets in the system delivered at site. Further, these additions shall not deteriorate the system parametric requirements like response time / duty cycle, etc. from those stipulated under this specification and shall meet other redundancy / functional requirement.

2.13.08 The above mentioned requirements are generally applicable for conventional system. For fieldbus based system refer Annexure IIIC-02K of Part-B for spare requirements. In FGs where mix of conventional and fieldbus based system is used, the spare shall be in the respective proportion.

2.14.00 The contractor has top provide kks codes for instrument and drives in the P&ID and other related document.

2.15.00 Output redundancy is applicable for 10% of drives distributed in various functional groups. Exact application shall be finalized during detailed engineering.

2.16.00 Complete wiring / cabling from field devices to panels / MCC and vice versa including conduits / trays / fixtures etc. shall be in bidders scope.

## 3.00.00 MEASURING INSTRUMENTS

The following shall be provided as a minimum, meeting specification requirements of Sub-section - MEAS INST of Part-B, Section-VI of Technical Specification.

3.01.01 Primary instruments like Microprocessor based transmitters employing HART/ Fieldbus protocol, thermocouples & RTDs along with temperature transmitters, pressure/diff. pressure/temperature/flow (Ultrasonic/electromagnetic) transmitter & gauges, flow sensing elements (orifice plates, flow nozzles etc), Ultrasonic, Radar type level transmitters, density meter (Coriolis type. In case the bidder proposes other type of density meter as per the bidder standard and proven practice, the same shall also be acceptable except Nucleonic type density meter), pH analyser, SO2 analyser, Flue Gas flow transmitter, vibration monitoring system (VMS) etc. for:

(a) FGD plant and other system being provided under the contract, as indicated in enclosed tender diagrams (Part E) of this specification.

(b) All Instruments which are Integral to equipment like pumps, motors etc. / skid mounted instruments and are not indicated in enclosed drawings (as applicable) or in BOQ etc. included in relevant sub-sections, but are required for control, monitoring and operation of the equipment/plant/ Systems are to be provided by the Contractor to meet actual system requirements meeting redundancy and other requirements specified under technical specifications subject to Employer's approval. Specification / type of instruments shall be as per standard and proven practice of equipment supplier. However, for temp elements including bearing / winding temp of motors / pumps temp transmitters shall be provided.

(c) For Binary and analog inputs required in major equipments of FGD system protection, triple-sensing devices shall be provided. Binary and analog

inputs, which are, required for protection of more than one equipment as well as protection signals for HT Drives etc., triple sensing devices shall be provided. Microprocessor based vibration monitoring system shall be provided for Booster Fans, Limestone Crusher, Milling System and all other equipments operating on 11kV/ 6.6kV/ 3.3kv. The number of bearing locations to be monitored on each equipment shall be as per requirements finalized during detailed engineering but not less than 2 (X and Y direction) bearing locations (except for vertical pumps for which one bearing location may be sufficient).

(d) For other critical binary and analog inputs required for protection and interlock purpose of other equipment (e.g. those interlocks which may result in loss of production, non-availability of a major equipment etc.), triple sensors shall be provided.

(e) Temperature elements, electronic transmitters etc. are to be provided for all the cases. Use of process actuated switches is acceptable only in the cases as indicated in the tender drawings.

3.01.02 All Pressure Transmitters, Differential Pressure Transmitters and Temperature Transmitters in this package shall be provided based on Fieldbus protocol (complying to specification of Part-B, Section-VI). The protocol of fieldbus based instruments shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer's approval.

**3.02.00** All weather analyser panel located in air conditioned containerised room (Portable cabin) shall be provided for housing analysers except In situ analysers. For balance instruments local panels which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved by Employer during detail engineering.

## 3.03.00 CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)

3.03.01 CEMS comprising of analysers and associated items for measurement of SO2, NOx, CO, CO2, Mercury, Particulate Matter (dust density), and Stack Flue Gas Flow in Stack emission shall be provided for each unit by the Contractor for stack emission monitoring.

A) **LIST OF FLUE GAS EMISSION ANALYSERS FOR CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)**

| S. No. | KKS CODE | DESCRIPTION | RANGE | ZONE | REMARK |
|---|---|---|---|---|---|

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 1 | HNE10CQ005 | SO2 in stack emission | 0-100 /0-1000 mg/Nm3 (SELECTABLE) | CHIMNEY | |
| 2 | HNE10CQ001 | NOX in stack emission | 0-100 /0-1000 mg/Nm3 (SELECTABLE) | CHIMNEY | Refer note-2 |
| 3 | HNE10CQ002 | CO2 in stack emission | 0-25% (Selectable) | CHIMNEY | |
| 4 | HNE10CQ004 | CO in stack emission | 0-100/ 0-1000 mg/Nm3 (SELECTABLE) | CHIMNEY | |
| 5 | HNE10CQ003 | Particulate Matter (Dust Density) in stack emission | 0-50 mg/Nm3 / 0 – 300 mg/Nm3 (PROGRAMMABLE) | CHIMNEY | |
| 6 | HNE10CQ006 | Mercury (Hg) in stack emission | 0 - 35 microgram/Nm3 | CHIMNEY | |
| 7 | HNE10CQ007 | Flue Gas flow at stack | To be Decided during Detail Engineering. | CHIMNEY | |

NOTES:

1. SO2, NOX, CO2 and CO analyser are shown separately for the purpose of input only otherwise SO2, NOX, CO2 and CO analyser may be supplied as a single unit/ Combined Unit (s) meeting specification requirement.

2. Direct measurement of NO and NO2 shall be done. Total NOx values shall be reported as NO2 i.e. NOx = NO + NO2 = NO X 1.53 + NO2 = NOx as NO2.

3. Oxygen (O2) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for correction of SO2, NOx and Particulate matter value corresponding to the standard/reference O2.

4. CEMS Parameters shall be normalized for temperature, pressure, moisture (applicable in case of wet measurement techniques), etc.. This facility shall be available in the respective analysers. Necessary measurement shall be provided by the Contractor for these parameters. All the CEMS parameters shall be reported on dry basis.

5. CO2 Measurement at stack and at instrument end shall be provided in case dilution techniques are used.

6. Offered CEMS should comply with latest CPCB/regulatory requirement prevailing at the time of award of the contract even if same is not explicitly indicated in the technical specification, without any cost implication to the Employer.

7. Offered CEMS shall be fully proven for the actual flue gas parameters at stack. Reference list and user feedback of offered CEMS in similar applications shall be furnished to NTPC for review during detailed engineering

| CLAUSE NO. | SCOPE OF SUPPLY & SERVICES |
|---|---|
| | stage.<br><br>8. These are per unit quantities.<br><br>9. Analyzers mentioned in S.No. 1 to 5 of the above *list of flue gas analyzers for CEMS* are not applicable for BARH-I project. However, Oxygen (O2) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for BARH-I project for correction of SO2, NOx and Particulate matter value corresponding to the standard/reference O2. |
| 3.03.02 | CEMS analysers/instruments shall be provided with provision for bidirectional connectivity over Modbus/RS-232/RS-485 with Employer's central cloud server for real time data monitoring, remote diagnostics & remote calibration checks, etc., complying with CPCB IT Division document "Protocol for real time (Emission & Effluent) data management from industries version 1.2 (10.6.2015), CPCB Guidelines July-2017 on CEMS or the latest regulatory requirement prevailing at the time of award of the contract. All necessary hardware and software required at instrument end shall be provided by the Contractor. Necessary details like scheme, register addresses of analyzer, etc. shall also be provided by the Contractor for implementation of above. The Contractor shall fully assist NTPC's agency involved in implementation of above connectivity. |
| 3.03.03 | For CEMS - In addition to above requirement, 4-20 mA connectivity to DDCMIS shall be provided by the Contractor. |
| 3.03.04 | Comprehensive Annual Maintenance Contract (AMC) for three (03) years after warranty period shall be provided by the contractor for CEMS and Analysers of FGD System. |
| **3.04.00** | **SERVICES DURING DEFECT LIABILITY PERIOD FOR CEMS AND ANALYSER INSTRUMENTS OF FGD** |
| 3.04.01 | The Contractor shall provide an unlimited warranty on all equipments during the Defect liability period. This warranty shall include repair, replacement, replenishment of consumables (for e.g. reagents, calibration gases etc. as applicable) and correction of identified discrepancies including Analysers, Sample Handling System, Transmitters, (as applicable) etc. at no cost to Employer. |
| 3.04.02 | The Contractor shall provide warranty spares including components for each system based on (and keeping adequate over margin) normally experienced failure rate. Exhaustive list of all such items shall be submitted along with Datasheet for Employer's review and approval during details Engg stage regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the Contractor along with the main equipment consignment. However for items which have a limited shelf life shall be dispatched in a phased manner during the warranty period. Unused spares/consumables shall be Contractor's property after expiry of warranty period and shall be taken back. |
| **3.05.00** | **SERVICES DURING ANNUAL MAINTENANCE CONTRACT (AMC) PERIOD FOR CEMS AND ANALYSER INSTRUMENTS OF FGD** |

3.05.01 The Contractor shall provide complete maintenance services for each System under comprehensive Annual Maintenance Contract (AMC) for period of three years after the Warranty period.

3.05.02 The AMC shall cover total maintenance of all Analysers, Sample Handling System, Transmitters etc. coming under the scope of each system and shall include free repair/replacement of each items, replenishment of consumables, correction of problems (if any) and supply of expendable items.

3.05.03 Further, Contractor may note that during the AMC he will be allowed to use Employer's mandatory spares, but has to replenish the same within three months' time or before completion of AMC period whichever is earlier.

3.05.04 The Contractor shall prepare detailed list of faults corrected and parts, expendables utilized during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Contractor's personnel.

3.05.05 Contractor shall also provide a list of all required AMC spares which shall be finalized along with datasheet during detail Engineering stage. These spares will be dispatched by the Contractor at the beginning of AMC on yearly requirement basis. However for items which have a limited shelf life shall be dispatched in a phased manner during the AMC period. Unused spare/consumable shall be Contractor's property after expiry of AMC period and shall be taken back.

**3.06.00 DEPUTATION OF ENGINEER/ TECHNICAL EXPERT FOR CEMS AND ANALYSER INSTRUMENTS OF FGD**

3.06.01 Contractor shall depute Technical Experts of the OAM /OEM/OES/ (Original Analyser Manufacturer/Original Equipment Manufacturer/Original Equipment supplier) for each of the above system at Site, who will be fully qualified to perform the required duties, supervision of maintenance, repair etc. for a period of six month. Employer will intimate the contractor two weeks advance notice for start of deputation period.

3.06.02 After expiry of above six month period, Technical expert for each system shall visit site on monthly basis for monitoring the performance and rectify the problem (if any) for each system for the remaining warranty period and during entire AMC period. In the event of any malfunction/fault/failure in the system or any component thereof contractor shall depute Technical expert of respective system to reach site within 48hrs of call raised by site during the remaining warranty period and entire AMC period.

3.07.00 Material Codification of C&I items in NTPC SAP system:

a. Contractor to provide detailed catalogue with complete part number of all the instruments, Electronic cards, accessories, JBs, Panels, etc. to Site Erection

Incharge within one month of supply of item at site for material codification of Main supply and mandatory spares items.
b. Contractor to depute his representative for 30mandays at site for codification of materials in NTPC SAP system in phased manner. The detail schedule of the program shall be finalized during commissioning stage at site.
c. The material codification of all the C&I items shall be completed before completion of commissioning and handover of system to site.

3.08.00 Contractor shall provide one no. of Hand held HART calibrator per generating unit.

## 4.00.00 PROCESS CONNECTION & PIPING

Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated under Sub-section PCP, Part-B, Section-VI of Technical Specification.

All transmitters, switches, temperature transmitters etc shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) In Local Instrument Racks (LIRs) in case of covered areas.

The instruments (electronic transmitters, temperature transmitters, level transmitters, flow transmitters/ flow meter) etc which are not located inside covered building shall be grouped (two or more) and mounted inside instrument racks. In case grouping is not possible and these are to be installed individually, canopy with suitable arrangement shall be provided. The grouping and design of racks/ canopy shall be approved by Employer during detail engineering.

Additionally, the same philosophy shall be applicable for switches except for those mounted on pipe and equipment.

All electric actuators, pneumatic control valves, JBs ,SOV box and Local control panels which are not installed inside covered building, suitable canopy shall be provided and design of canopy shall be approved by Employer during detailed engineering.

## 5.00.00 INSTRUMENTATION CABLES, C & I SYSTEM, POWER SUPPLY DISTRIBUTION CABLES & CABLE SUB-TRAYS

5.01.00 a) All instrumentation cables (twisted & shielded, FRLS PVC insulated and sheathed), data highway / fibre optical cables including prefabricated cables (with plug-in connectors), cables as applicable for direct interconnection of two equipment/ system/ devices in Contractor’s scope as well as for connection of signals from/to systems like MCC/LT SWGR/HT SWGR etc. (even if they are not in Contractor’s Scope.) shall be provided by Contractor on as required basis.

b) All power supply distribution cables required for directly connecting two equipment / systems devices in contractor's scope shall be provided by the contractor. All these cables shall be FRLS & as per IS-1554 Part – I latest edition.

c) Above cables shall be provided along with necessary laying & termination accessories, hardware etc. meeting requirements specified under Sub-section INST CABLE, Part -B, Section-VI of Technical Specification. All sub trays along with supporting, connecting hardware etc. required for laying of instrumentation, control, power and other cables etc. up to main cable trays are under Bidders scope.

d) Cables required for interfacing FGD DDCMIS with Employers DDCMIS (both SG and BOP) located in CER shall be in bidder's scope.

e) Cables for connectivity of CEMS signals to Employer's Unit DDCMIS located in unit CER shall be in bidder's scope.

f) Junction boxes with requisite terminals shall be provided on as required basis. Grouping, Assignment, Sequence of termination of various field instruments /drive signals (if applicable) to Local junction boxes shall be subject to Employer's approval during detailed engineering.

## 6.00.00 CONTROL VALVES & ACTUATORS

6.01.00 Control valves, actuators and accessories, shall be provided on as required basis for meeting requirements specified under Sub-section CONTROL VALVE, Part-B, Section-VI of Technical Specification. Specially designed valves/trims to prevent cavitations and limit noise and control outlet velocity, shall be provided.

6.02.00 Microprocessor Based Electronic Positioner is to be provided on as required basis with all the Control valves and all control dampers being provided by the contractor.

## 7.00.00 ELECTRICAL POWER SUPPLY

Microprocessor based modular 24V DC power supply system shall be used for powering the control systems including its network devices.

24V DC power supply system for DDCMIS based control system shall comprise of two sets, each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller – one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.

Contractor shall provide UPS of suitable capacity for the intended application meeting the requirements of Technical Specifications as stipulated under Part B, Section VI. Contractor shall provide Mini UPS for each server station as minimum.

Contractor to note that UPS of configuration C is acceptable only upto 5 KVA. In case the consolidated load requirements exceeds 5 KVA, Contractor to provide UPS with Configuration B in place of Configuration C as per Technical Specifications as Part B, Section VI.

Bidder shall provide power supply distribution panels/cabinets/boxes for sub distribution of DC/Main UPS/Utility feeders on as required basis. The power supply distribution box shall include change over circuitry, switch fuse units, MCBs, terminal blocks etc. suitable for application.

For detailed requirements of FGD system, refer Sub-Section III-C, Part B Section VI of technical specifications.

**8.00.00 TYPE TEST REQUIREMENT**

The type tests to be conducted for C&I systems & equipments shall be as detailed out in Sub-Section-C-06 Type Test Requirements, Part-B, Section-VI of Technical Specification.

**9.00.00 TOOLS & TACKLES**

The Contractor shall furnish a complete new set of all special tools and tackles of reputed make and model which are required for erection, ease in maintenance to have minimum down time, testing and calibration of all the equipments and systems to be provided by the Contractor under this specification for C&I systems.

**10.00.00 Interfacing with Employer’s DDCMIS**

10.01.00 Hardwired Signal exchange: Hardwired signal exchange between BOP DDCMIS/ CHP DDCMIS (under Employer's scope) and FGD DDCMIS (under Contractor's scope) like bypass damper status, inlet and outlet gates status, ID Fans status, ESPs status, Boiler Load Index (BLI), MFT etc. shall be provided on as required basis, for implementation of protections and interlocks. Contractor shall provide one Remote Input Output (RIO) per unit, placed in Central Equipment Room (CER) for the same. However, contractor to consider IOs and cables for minimum number of hardwired signal exchange per unit as follows DI – 130, DO – 130, AI – 50 and AO – 50. NTPC shall provide 2 (Two) nos. of 24V DC power supply feeders per unit from employer's DCDB, for powering RIO panel located in CER. Cabling from DCDB to RIO panel (located in CER) shall be in bidder's scope of supply.

10.02.00 The Contractor shall provide all assistance to the BOP C&I (in Employer's scope) supplier including co-ordination and flow of required information etc.

10.03.00 Contractor shall provide complete logics for FGD and associated system such as booster fan blade pitch control, FGD bypass damper control, FGD inlet and outlet gate control etc. FGD OEM shall furnish recommendations, if any, for implementation in employer's DDCMIS for boiler control.

10.04.00 Contractor to refer the General Layout Plan (GLP) to estimate the distance between FGD control room and Employer's CCR/CER.

**11.00.00 Grounding System**

Suitable electronic grounding is to be provided by the contractor for all C&I equipments/panels/desk in the scope of the contractor. The exact scheme shall be as finalized during detailed engineering. Also refer Sub-Section titled "Basic Design Criteria" in Part-B, of this Technical Specification.

**12.00.00 Electric Actuators**

Fieldbus based Non-Intrusive Electrical Actuators with integral starters along with associated accessories etc. shall be supplied on as required basis for Valves / Dampers to meet the functional and the other specification requirements specified elsewhere in the Technical specification.

For detailed specification refer chapter "Electric Actuator", Part B, Section-VI. These actuators shall comply the common requirements of actuators as specified at clause 2.00.00 and specific requirements of Non-Intrusive fieldbus actuators as specified at clause 4.00.00. Specific requirements of Non-Intrusive hardwired actuators specified in clause no. 3.00.00 are not applicable for this project. For Blade pitch actuators specification clause no. 5.00.00 shall be complied.

The protocol of fieldbus based non-intrusive electric actuators shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer's approval.

For erection and commissioning of above specified actuators, qualified and experienced engineers of actuator manufacturer shall be deputed at site. After successful commissioning of actuators, minimum one qualified and experienced engineer of main package supplier/ actuator manufacturer shall be continuously available at site up to completion of defect liability period (warranty) of actuators, for troubleshooting and maintenance of actuators and proper interfacing with DDCMIS. Qualified and experienced engineers indicated above shall have expertise in all aspects of non-intrusive actuators along with fieldbus protocol and interfacing with DDCMIS.

**13.00.00 CONTROL DESK , PANELS AND FURNITURES**

Contractor shall provide control desk placed in FGD common control room, Central Control Room (CCR) meeting specification requirements stipulated under sub section Control Desk, Panels and Furniture PART-B, Section VI of technical specification.

Contractor shall provide control desk in CCR of each generating unit, of length 2 meter aesthetically matching with the existing control desk of main plant Central Control Room (CCR) for placing FGD OWS in main plant CCR.

The minimum quantity of furniture per generating unit, envisaged in FGD control room is as mentioned below:

a) Chair-3 nos.

b) Printer table- 1 no

c) Computer table- 2 no.

d) Key pad- 1 no.

e) Locker set -1 no

Server rack, PC rack and workstation furniture shall be provided on as required basis.

## 14.00.00 SCOPE OF SERVICES

14.01.00 The Contractor or his sub-vendor(s) / associate(s) / engineering firm(s) shall have established engineering setup including skilled & experienced manpower, engineering software(s) and other required resources for carrying out basic and detailed engineering of control and instrumentation systems of FGD System. The Control and Instrumentation engineering shall include the following as a minimum.

a. Preparation of basic logic / loop diagrams (not just the implementation), I/O list, Drive list, instrument list etc for each of the plant areas of the complete plant including offsite systems based upon the flow schemes / write ups by the OEM's.

b. Engineering of power supply system for DDCMIS, Process connection and piping, Control valves etc.

c. Instrumentation, cable engineering including preparation of interconnection cable diagram, cable schedule etc.

d. The contractor shall deploy certified and experienced engineers in the system design of fieldbus during engineering and commissioning of fieldbus

system. Further, the certified fieldbus engineers shall be available during commissioning of fieldbus instruments and actuators. Protocol will be signed with NTPC site engineer for successful commissioning of fieldbus instruments, actuator along with control system. The name(s) of such certified fieldbus commissioning engineer's shall be approved by Employer and for this the contractor shall submit CV/ experience details of proposed engineers.

Further, the contractor shall provide training to employer's personnel on following aspects of fieldbus (i) Hardware & Software features (ii) System design, diagnostic and testing (iii) maintenance, troubleshooting and fault analysis. This training shall be provided by certified training agencies of foundation fieldbus/ Profibus foundation and it shall be provided before approval of basic design and engineering document.

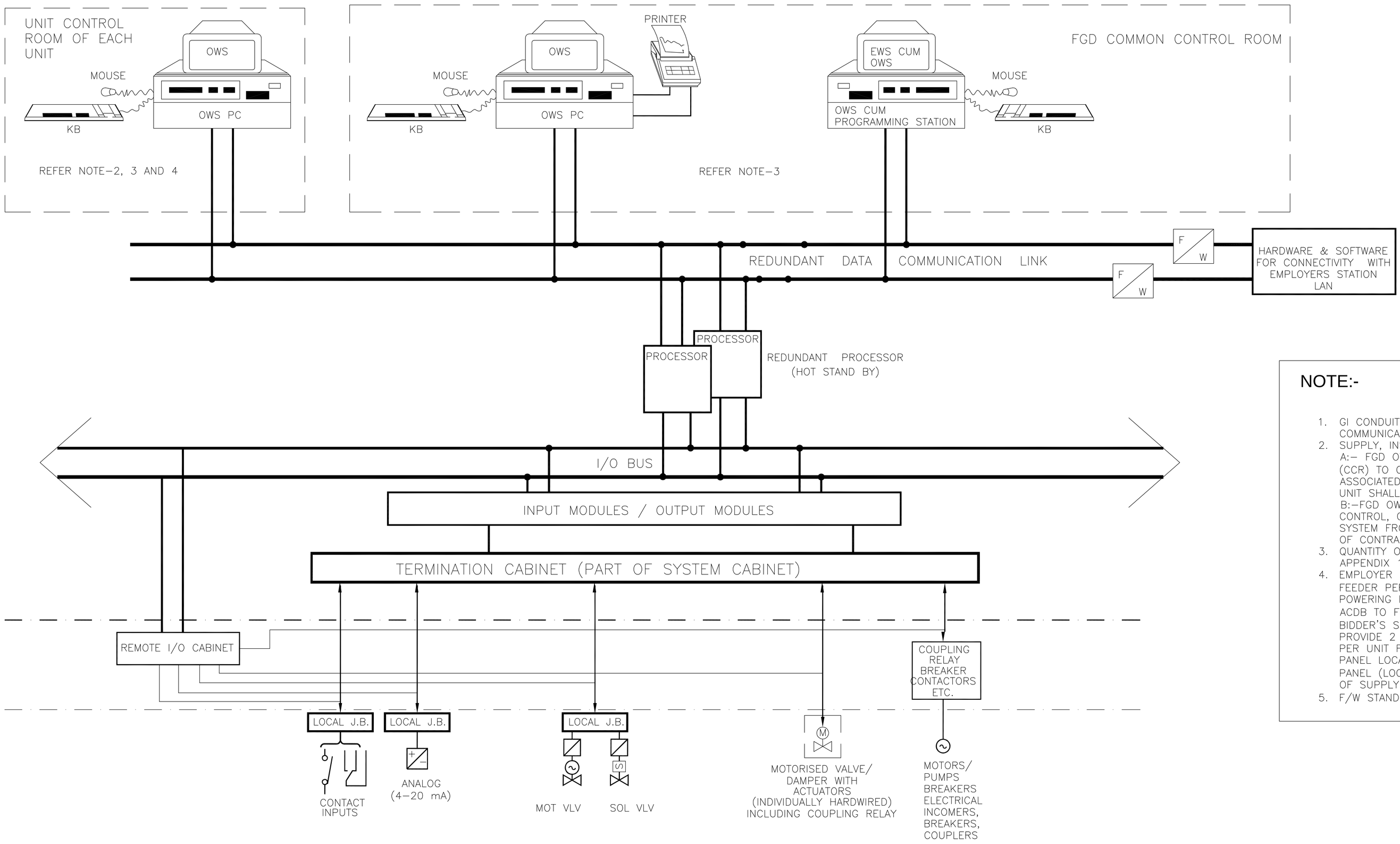
The block logics shall be in the format as approved by NTPC during detailed engineering stage.

For other services refer relevant sections of bidding documents.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | **Operating Devices & their locations** | | | | | | |
| | | | | | | | |
| | | **Flue Gas Desulphurization (FGD) HMI** | | | | | |
| | | **Units** | **Qty per unit** | **Qty-Common** | **Location** | **Areas for which Primary Operating Point** | **Areas for which Secondary Operating Point** |
| | OWS **for operation from Main plant Units** | **No** | **2** | | In each Unit Control Room | | Absorber and associated systems of respective Unit, Gypsum dewatering handling, Lime Stone preparation & handling and other systems being supplied under the contract. |
| | **OWS for FGD common control room** | **No** | | **4 (applicable for project with one generating unit/stage)<br>5 (applicable for project with two generating unit/stage)<br>6 (applicable for project with three generating unit/stage)<br>7 (applicable for project with four generating unit/stage)** | **FGD common control room** | Absorber and associated systems of respective Unit, Gypsum dewatering handling, Lime Stone preparation & handling and other systems being supplied under the contract. | |
| | | **Flue Gas Desulphurization (FGD) HMI** | | | | | |
| | | **Units** | **Qty per unit** | **Qty-Common** | **Location** | **Remarks** | |
| | Servers / Information Workstations | No | | **2** | FGD Common Control Room | These shall function in redundant mode. OWS functionality is to be merged with Servers / Information Stations. | |
| | Programmer cum Documentation Station ( Refer note-2) | No | | **1** | FGD Common Control Room | | |
| | Laser jet colour printer ( A4 size) | No | | **1** | FGD Common Control Room | | |
| | | **Hardware for connectivity with Employer's Station LAN** | | | | | |
| | Station wide redundant LAN | set | | **1** | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Hardware Firewall in failover mode | Nos | | **2** | | | |
| | Network Management Software | set | | **1** | | | |
| | Test Server alongwith requisite Software | set | | **1** | | | |
| | Mini UPS (1 no. for each Server Grade Machine) | | | | | | |
| | HMIPIS Cabinets: Cabinets for mounting network components & power supply distribution equipment (for each DDCMIS, Station LAN etc.) | | On as required basis | On as required basis | | | |
| | 1.Not used | | | | | | |
| | Not used | | | | | | |
| | 2. (i) In case, separate control system programming device is required, same shall be provided for each DDCMIS system. | | | | | | |
| | (ii) For each of the non-DDCMIS based controls being provided for any system, 1 set of programming tool for each such system shall be provided to view & change logic/program/settings. | | | | | | |
| | 3. Redundant master clock are located in CER. Interconencting cables shall be on as required basis. | | | | | | |
| | 4. Software for DDCMIS meeting requirements specified under item "SYSTEM SOFTWARE REQUIREMENTS" sub-section DDCMIS, Part-B, Section-VI of technical speciifcations shall be on as required basis for all the DDCMIS. | | | | | | |
| | 5. Data communication system shall be on as required basis. One set of suitable interfaces and links for connectivity between FGD unit LAN, FGD common LAN and employer's Station LAN shall be provided per DDCMIS, as applicable. Cubicles for mounting networking components and power supply distribution equipment shall be provided on as required basis. | | | | | | |
| | 6. Not used | | | | | | |
| | 7. Not used | | | | | | |
| | 8. Not used | | | | | | |
| | 9. Not used | | | | | | |
| | 10. Not Used | | | | | | |
| | 11. Spare Capacity for HMIPIS | | | | | | |
| | Each Sub-system HMIPIS shall be provided with capacity to handle at least 30% of each type of peripherals/equipments, additionally, like OWS, printers, etc, over and above already specified, without any additional hardware or software. Further, the Data communication system (including Main system Bus and other bus system), HMIPIS database, Server/Information workstation etc. shall be able to handle 30% extra signals over and above all process as well as calculated (at controller level) signals including the tag nos./process variables being acquired from other DDCMIS sub-system through various links meeting the specification requirements. Usable space of 20% shall also be kept in network panels of each HMIPIS for mounting network components. | | | | | | |

# C&I ANNEXURE-IX




NOTE:-

1. GI CONDUIT SHALL BE PROVIDED FOR IO BUS/DATA COMMUNICATION LINK LEAVING FGD CONTROL ROOM.
2. SUPPLY, INSTALLATION AND COMMISSIONING OF:
   A:– FGD OWS PLACED IN CENTRAL CONTROL ROOM (CCR) TO CONTROL, OPERATE AND MONITOR FGD AND ASSOCIATED SYSTEM FROM MAIN PLANT CCR OF EACH UNIT SHALL BE IN SCOPE OF CONTRACTOR.
   B:–FGD OWS PLACED IN FGD CONTROL ROOM TO CONTROL, OPERATE AND MONITOR FGD AND ASSOCIATED SYSTEM FROM FGD CONTROL ROOM SHALL BE IN SCOPE OF CONTRACTOR.
3. QUANTITY OF HMI HARDWARE SHALL BE AS PER THE APPENDIX 1 ANNEXURE II.
4. EMPLOYER SHALL PROVIDE 02 NOS. OF UPS POWER FEEDER PER UNIT FROM EMPLOYER'S ACDB, FOR POWERING FGD OWS LOCATED IN CCR CABLING FROM ACDB TO FGD OWS (LOCATED IN CCR) SHALL BE IN BIDDER'S SCOPE OF SUPPLY. EMPLOYER SHALL PROVIDE 2 NOS. OF 24V DC POWER SUPPLY FEEDERS PER UNIT FROM EMPLOYERS DCDB, FOR POWERING RIO PANEL LOCATED IN CER. CABLING FROM DCDB TO RIO PANEL (LOCATED IN CER) SHALL BE IN BIDDER'S SCOPE OF SUPPLY.
5. F/W STANDS FOR FIREWALL.

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एन टी पी सी NTPC

*NTPC Limited*

( A GOVERNMENT OF INDIA ENTERPRISE )

ENGINEERING DIVISION

| REV.NO. | DESCRIPTION | DRAWN | DESIGN | CHKD. | CLEARED BY M | E | C | C&I | ARCH. | APPD | DATE |
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PROJECT:– TYPICAL THERMAL POWER PROJECT

TITLE:– STANDARD CONFIGURATION DIAGRAM FOR CONTROL SYSTEMS

| SIZE | SCALE | DRG. NO. | REV. NO. |
|---|---|---|---|
| A4 | N.T.S. | 0000-151-POI-A-013 | C |

TENDER NO PSER:SCT:NMN:C0607:20

## CONTAINERISED ROOM (PORTABLE CABIN)

### 1.00.01 Enclosure rating & Design

- For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.

- CONTAINERISED ROOM (PORTABLE CABIN) shall be designed for outdoor application.

### 1.00.02 General Description

The Containerised room shall meet all requirements of analysers and analyser panels.

- Containerised room would be closed type, weather proof and made of CRCA steel construction.
- It shall withstand heavy monsoon, heavy rain and heavy wind condition.
- Doors would be equipped with hydraulic door closer.
- Each door shall be fitted internally with "panic" bar exit handles and externally with key lockable handles. Exterior handles will be of stainless steel.
- Door will be provided with heavy-duty latches, hinges, door stop and pad lock.
- Personnel doors would be provided with canopy with necessary rubber gaskets to prevent the entry of water.
- The Containerised room shall be air-conditioned to maintain an air temperature less than 27°C.
- The Containerised room shall be designed as multiple modular transportable units; they shall be modularized for ease of separation for transport and quick re-assembly at site.
- Split Modules shall be designed for lifting as single piece along with equipment's.
- Lifting lugs should be designed to carry the weight of the Containerised room including all the Electrical panel boards.
- Suitable lifting provisions and accessories shall be provided along with Containerised room.

### 1.00.03 Structural Arrangements

#### 1) Frame

The pre-fabricated enclosure(s) frame shall be constructed as a rigid, self-supporting steel structure. Structural steel design and fabrication shall be in accordance with AISC Manual of Steel Construction.

**Construction Materials**

| | |
|---|---|
| * Steel: load bearing members: | IS 10748; Grade IV |
| * Structural Steel: | IS 2062. |
| * Side-end walls & roof panels: | IS 2062. |

* Square/Rectangular hollow sections: JIS STKR-41 / IS 1161

The roof framing and the columns shall be designed to support any additional dead load suspended from the roof such as air conditioning duct, false ceiling, cable trays, light fixtures, and piping.

The pre-fabricated enclosure(s) floor framing (skid) shall be fabricated from ASTM A36/ JIS 3101 or Equivalent steel members to form a rigid rectangular frame. The frame shall be braced with cross members as required to support the equipment installed in the building.

The pre-fabricated enclosure(s) shall be analyzed to resist both dead and live loads expected during construction, transportation, installation, and operation.

The pre-fabricated enclosure(s) shall be designed for the maximum in-place Structural loading consisting of the structure, equipment dead weight, all operating loads, and the maximum environmental loads

**2) Shell and Base frame**

The outer shell of the Containerised room shall be manufactured with 1.6mm sheet. The main load bearing members such as posts, base members, bottom and top side rails, end rails headers are selected based on approved structural analysis. Lifting hooks shall be provided at minimum at corners. The adequacy of the same shall be verified by structural analysis.

Adequate number of doors with reinforced framework and locking device shall be provided as per requirement. The door has to be effectively sealed against water ingress in closed condition. The shell structure is to be rigid enough to withstand rough handling rigorous transportation hazards etc. and able to stand flexing/distortion even when placed on uneven ground.

Base members are to be made from press formed steel sections of appropriate Geometry of required thickness. Base frame design shall be accommodating the panels provided inside the room.

Panel mounting structure shall be fabricated and drilled with holes for fixing bolts for the site erection panel during site erection. 16 gauge galvanized sheet for cable protection at the bottom sheeting plate.

**3) Side & End Walls**

External walls are to be vertically corrugated 1.6 mm thick GI/CRCA conforming to IS 2062/IS 513.

The corrugated panels shall form entire side wall and the assembled side wall shall be assembled with the peripheral frame members.

**4) Roof**

The roof has to be manufactured from 1.6 mm thick GI/CRCA conforming to IS 2062. The roof will have sloping arrangement for effective drainage.

**5) Flooring System**

Floor plating shall be covered with a non-skid surface. The exposed floor shall be covered with a insulating material as per statutory requirement.

**6) Insulation**

Containerised room will be insulated on sides, end walls, roof & doors with 50mm thick Glass Wool/Rockwool insulation. Densities should be 48 kg/m3

**7) Inner Paneling**

Interiors of the Containerised room shall be aesthetically finished so as to give a pleasing appearance with high quality workmanship. All joints shall be neatly finished. For side, roof and end walls paneling will be done with 1.6mm thick Galvanized sheet.

**8) Doors**

All exterior doors shall be of weather-proof construction with four sided frames. All exterior hardware shall be stainless steel, including, but not limited to hinges. Hinges shall be concealed type. If non concealed type then the hinge should be tamper proof arrangement.

Doors shall be fabricated from aluminum with SS panic hardware. Doors shall be lockable with one key for all doors. Provide four keys total.

Two doors of Aluminum shall be provided unless otherwise specified. One equipment door and one personnel door shall be provided. The size of equipment door shall be as per equipment sizing. One personnel door minimum 1.2M x 2.5M shall be provided. Doors shall be of 4 hours fire rated.

**9) Protective Coating Procedure**

All steel structure members shall be cleaned prior to finishing.
Standard interior finish shall be white. After welding do abrasive blast – SA 2 1/2 thereafter below process to be adapted

**A) Internal Panels Painting (Walls & Roof) :-**

Powder Paint Sheet

- Surface Preparation/Primer :Intercure 200HS Min 150 um
- Finish : Interthane 990 Min 50 um
- Total Minimum DFT shall be 200 um

**B) Exterior Panels Painting (Walls, Roof & Base structure) :**

Powder Paint Sheet

- Surface Preparation/Primer : Interzinc 52 Min 75 um
- Coating : Interguard 475HS Min 200 um

- Finish : Interthane 990 Min 50 um
- Total Minimum DFT shall be 325 um

Both Interior and exterior panels, roof and base frame will be painted in colour shade of RAL 5012.

**10) Grounding**

Internal Earthing inside enclosure with suitable cross sectional GI flats. The building shall be furnished complete with ground pads which shall bond of electrical equipment enclosure frames and ground buses to the building frame at the exterior base in two locations and at opposite ends of the building so as to provide a continuous path to ground. The Grounding system shall connect to each end of the ground bus in each assembly of installed equipment.

**11) Lighting**

The lighting system shall maintain minimum levels as given below:

Lux level shall be 200 inside the Containerised room and outside platforms/ stairs shall be 100 Lux.
All luminaries shall be suitable for industrial duty and provided with IP65 housings for outdoor enclosures and IP54 for indoor enclosures. All fittings shall be weatherproof and able to withstand direct hosing. The wiring for lighting shall be routed through GI conduits either concealed or the wall of the enclosure
External light around Containerised room only shall be considered. All Light Fixtures shall be high efficiency LED type only.

**12) Lifting Tools and Tackles**

Suitable lifting system shall be designed and furnished. The system will consist of a spreader bar, slings, shackles and other tools to lift the equipment building in one piece
A lifting system installation & operational diagram shall accompany all shipping documents.

**Civil Annexure-1**

**Mauda TPP**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration | : 0.17g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.043 |
| b) | For special concentrically braced steel frames designed and detailed as per IS:800 | : 0.032 |
| c) | For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.026 |
| d) | for RCC chimney | : 0.085 |
| e) | For Liquid retaining tanks | : 0.051 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.064 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.043 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.085 |

Note:

1. g = Acceleration due to gravity
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015

**KUDGI STPP**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.15g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.038 |
| b) | For special concentrically braced steel frames designed and detailed as per IS:800 | : 0.028 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.023 |
| d) | for RCC chimney | :0.075 |
| e) | For Liquid retaining tanks | :0.045 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.056 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.038 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.075 |

Note:

1. g = Acceleration due to gravity
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015

**GADARWARA STPP**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.18g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.045 |
| b) | for special concentrically braced steel frames designed and detailed as per IS:800 | : 0.034 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.027 |
| d) | for RCC chimney | : 0.09 |
| e) | For Liquid retaining tanks | :0.054 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.068 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.045 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.09 |

Note:

1. g = Acceleration due to gravity.
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015.

**DARLIPALI STPP**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.10g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.025 |
| b) | for special concentrically braced steel frames designed and detailed as per IS:800 | : 0.019 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.015 |
| d) | for RCC chimney | :0.05 |
| e) | For Liquid retaining tanks | :0.03 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.038 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.025 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.05 |

Note:

1. g = Acceleration due to gravity.
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015.

**SOLAPUR STPP**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.16g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.04 |
| b) | for special concentrically braced steel frames designed and detailed as per IS:800 | : 0.03 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.024 |
| d) | for RCC chimney | :0.08 |
| e) | For Liquid retaining tanks | : 0.048 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.06 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.04 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.08 |

Note:

1. g = Acceleration due to gravity.
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015.

**TANDA STPP**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.16g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.04 |
| b) | for special concentrically braced steel frames designed and detailed as per IS:800 | : 0.03 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.024 |
| d) | for RCC chimney | :0.08 |
| e) | For Liquid retaining tanks | : 0.048 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.06 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.04 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.08 |

Note:

1. g = Acceleration due to gravity.
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015.

**MEJA STPP**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.12g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.03 |
| b) | for special concentrically braced steel frames designed and detailed as per IS:800 | : 0.023 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.018 |
| d) | for RCC chimney | : 0.06 |
| e) | For Liquid retaining tanks | : 0.036 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.045 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.03 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.06 |

Note:

1. g = Acceleration due to gravity.
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015.

**NEW NABINAGAR STPP**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.16g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.04 |
| b) | for special concentrically braced steel frames designed and detailed as per IS:800 | : 0.03 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.024 |
| d) | for RCC chimney | : 0.08 |
| e) | For Liquid retaining tanks | : 0.048 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.06 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.04 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.08 |

Note:

1. g = Acceleration due to gravity.
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015.

**LARA STPP** **Civil Annexure-2**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration | : 0.16g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | For special moment resisting steel frames designed and detailed as per IS:800 | : 0.04 |
| b) | For special concentrically braced steel frames designed and detailed as per IS:800 | : 0.03 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.024 |
| d) | for RCC chimney | :0.08 |
| e) | For Liquid retaining tanks | :0.048 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.06 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.04 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.08 |

Note:

1. g = Acceleration due to gravity
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015.

**BARH STPP** Civil **Annexure-3**

## SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration | : 0.24g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | For special moment resisting steel frames designed and detailed as per IS:800 | : 0.06 |
| b) | For special concentrically braced steel frames designed and detailed as per IS:800 | : 0.045 |
| c) | For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.036 |
| d) | for RCC Chimney | : 0.12 |
| e) | for Liquid retaining tanks | : 0.072 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.09 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below in general (excluding special structure/ configuration/materials) | : 0.06 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.12 |

Note:

1. g = Acceleration due to gravity
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015

**NABINAGAR STPP** Civil **Annexure-4**

## SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

| | | |
|---|---|---|
| 1) | Peak ground horizontal acceleration (MCE) | : 0.16g |
| 2) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra | |
| a) | for special moment resisting steel frames designed and detailed as per IS:800 | : 0.04 |
| b) | for special concentrically braced steel frames designed and detailed as per IS:800 | : 0.03 |
| c) | for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 | : 0.024 |
| d) | for RCC chimney | :0.08 |
| e) | For Liquid retaining tanks | : 0.048 |
| f) | for Steel chimney, Absorber tower, Vessels | : 0.06 |
| g) | for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) | : 0.04 |
| 3) | Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted | : 0.08 |

Note:

1. g = Acceleration due to gravity.
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015.

TENDER NO PSER:SC

Civil Annexure-5 (Borelog)

# BORE LOG

Annexure-II (Lara-I)

**PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.**

BH No.: 53
Depth : 35.00 m
Depth of Water table : 4.50 m

RL: 203.250

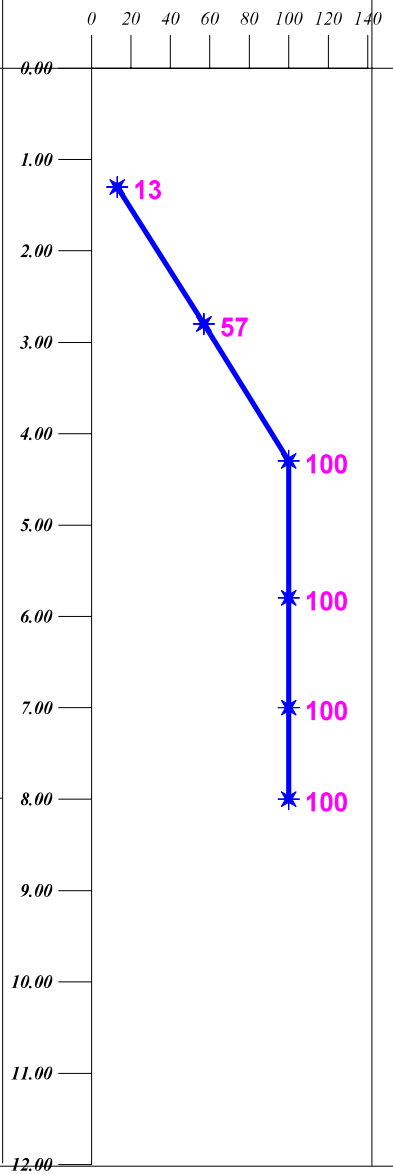
Date of start : 13/02/2012

Date of finish : 20/02/2012

**Project No. 1930** Location: Chinmey Co-Ordinates: 152E, 1957S

| Reduced Level | Depth (m) | Type of sample | Soil Classification | Gravel | Sand | Silt/Clay | r(wet) | r(dry) | W(%) | L.L | P . L | Sp.Gr | Type of test | C(kg/sq.cm) | phi(degrees) | Cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 203.250 | 0.00 | | | | | | | | | | | | | | | |
| 201.950 | 1.30 | SPT | | | | | | | | | | | | | | |
| 200.450 | 2.80 | SPT | | | | | | | | | | | | | | |
| 199.750 | 3.50 | UDS | Sandy Silt with Gravel (SM-ML) | | | | | | | | | | | | | |
| 198.950 | 4.30 | SPT | | | | | | | | | | | | | | |
| 197.450 | 5.80 | SPT | | | | | | | | | | | | | | |
| 196.250 | 7.00 | SPT | | 8 | 12 | 80 | | | | Non Plastic | | | | | | |
| 195.250 | 8.00 | SPT | | | | | | | | | | | | | | |
| | | | Refusal Strata | | | | | | | | | | | | | |

S.P.T Plot — Observed



# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Co-Ordinates: 152E, 1957S

Job No: 1930

Location: Chinmey  BH No.: 53  DEPTH : 35.00 m  Depth of Water Table : 4.50 m

Date of Start : 13/02/2012  Date of Finish : 20/02/2012

| REDUCED LEVEL | DEPTH | LITHOLOGY: DESCRIPTION | LOG | Size of core pieces: < 10 mm size | 10 to 25 mm | 25 to 75 mm | 75 to 150 mm | > 150 mm | STRUCTURAL CONDITIONS: DESCRIPTION | PERCENT CORE RECOVERY | RQD | SIZE OF HOLE | GROUT | CASING: OTHER SIZES | DEPTH OF WATER LEVEL | WATER LOSS: NO | PARTIAL | COMPLETE | PERCOLATION TEST: TEST SECTION | BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) | LOSS(l/m) | BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL | TIME INTERVAL | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 195.150 | 8.10 | Highly weathered disintegrated Rock | | | | | | | | | | | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 194.250 | 9.00 | | | | | | | | | | | | | | | | | | | | | | | | CR(CM)=16 CR(%)=11 RQD(%)=Nil N>100 |
| 192.750 | 10.50 | | | | | | | | | | | | | | | | | | | | | | | | CR(CM)=21 CR(%)=14 RQD(%)=Nil N>100 |
| 191.250 | 12.00 | | | | | | | | | | | NX | | | | | | | | | | | | | CR(CM)=43 CR(%)=29 RQD(%)=Nil N>100 |
| 189.750 | 13.50 | Highly weathered highly fractured grey to pinkish color Limestone | | | | | | | | | | | | | | | | | | | | | | | CR(CM)=22 CR(%)=15 RQD(%)=Nil N>100 |
| 188.250 | 15.00 | | | | | | | | | | | NX | | | | | | | | | | | | | CR(CM)=10 CR(%)=7 RQD(%)=Nil N>100 |
| 186.750 | 16.50 | | | | | | | | | | | | | | | | | | | | | | | | CR(CM)=19 CR(%)=13 RQD(%)=Nil N>100 |
| 185.250 | 18.00 | | | | | | | | | | | | | | | | | | | | | | | | CR(CM)=32 CR(%)=21 RQD(%)=Nil N>100 |
| 183.750 | 19.50 | | | | | | | | | | | NX | | | | | | | | | | | | | CR(CM)=34 CR(%)=23 RQD(%)=Nil N>100 |
| 182.250 | 21.00 | | | | | | | | | | | | | | | | | | | | | | | | CR(CM)=15 CR(%)=10 RQD(%)=Nil N>100 |
| 180.750 | 22.50 | | | | | | | | | | | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Co-Ordinates: 152E, 1957S

Job No: 1930

Location: Chinmey BH No.: 53 DEPTH : 35.00 m Depth of Water Table : 4.50 m

Date of Start : 13/02/2012 Date of Finish : 20/02/2012

| REDUCED LEVEL | DEPTH | LITHOLOGY DESCRIPTION | LOG | Size of core pieces | STRUCTURAL CONDITIONS DESCRIPTION | PERCENT CORE RECOVERY | RQD | SIZE OF HOLE | GROUT | CASING OTHER SIZES | DEPTH OF WATER LEVEL | WATER LOSS | PERCOLATION TEST | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 180.750 | 22.50 | Highly weathered highly fractured greyish to pinkish color Limestone | | < 10 mm size, 10 to 25 mm, 25 to 75 mm, 75 to 150 mm, > 150 mm | | 0 20 40 60 80 100 | 0 20 40 60 80 100 | NX | | mmNX BX AX | | NO PARTIAL COMPLETE 0 20 40 60 80 100 | TEST SECTION; BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm), LOSS(l/m); BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL, TIME INTERVAL | | CR(CM)=17 CR(%)=11 RQD(%)=Nil N>100 |
| 179.250 | 24.00 | | | | | | | | | | | | | | CR(CM)=16 CR(%)=11 RQD(%)=Nil N>100 |
| 177.750 | 25.50 | | | | | | | NX | | | | | | | CR(CM)=33 CR(%)=22 RQD(%)=Nil N>100 |
| 176.250 | 27.00 | | | | | | | | | | | | | | CR(CM)=20 CR(%)=13 RQD(%)=Nil N>100 |
| 174.750 | 28.50 | | | | | | | NX | | | | | | | CR(CM)=31 CR(%)=21 RQD(%)=Nil N>100 |
| 173.250 | 30.00 | | | | | | | | | | | | | | CR(CM)=42 CR(%)=28 RQD(%)=Nil N>100 |
| 171.750 | 31.50 | | | | | | | | | | | | | | CR(CM)=35 CR(%)=23 RQD(%)=Nil N>100 |
| 170.250 | 33.00 | | | | | | | NX | | | | | | | CR(CM)=30 CR(%)=20 RQD(%)=Nil N>100 |
| 168.750 | 34.50 | | | | | | | | | | | | | | CR(CM)=12 CR(%)=24 RQD(%)=Nil N>100 |
| 168.250 | 35.00 | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# BORE LOG

**PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.**

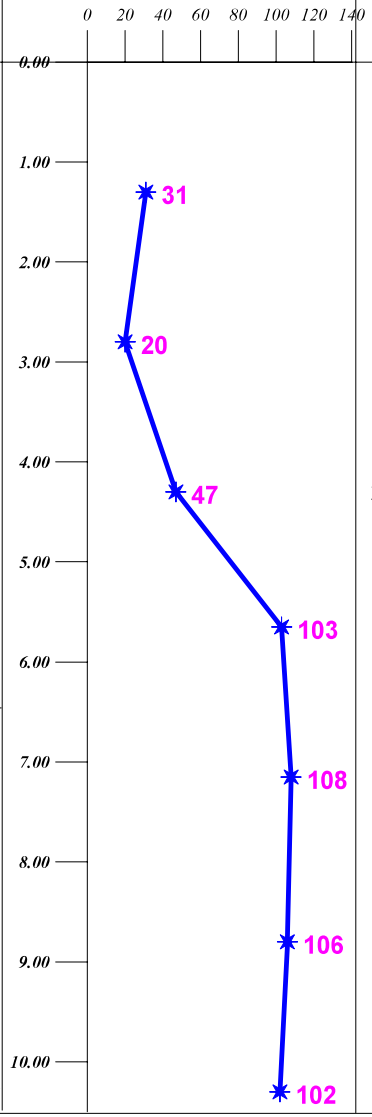
**BH No.: 54** RL: 203.190
**Depth : 45.00 m**
**Depth of Water table : 5.25 m**

Date of start : 02/01/2012
Date of finish : 10/01/2012

**Project No.1930** Location: Space for FGD II Co-Ordinates: 180E, 1957S

| Reduced Level | Depth (m) | Type of sample | Soil Classification | Gravel | Sand | Silt/Clay | r(wet) | r(dry) | W(%) | L.L | P . L | Sp.Gr | Type of test | C(kg/sq.cm) | phi(degrees) | Cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 203.190 | 0.00 | | | | | | | | | | | | | | | |
| 201.890 | 1.30 | SPT | | 9 | 21 | 70 | | | | 35 | 18 | | | | | |
| 200.390 | 2.80 | SPT | Silty Clay of medium Plasticity (CI) | | | | | | | | | | | | | |
| 199.690 | 3.50 | UDS | | | | | 1.86 | 1.53 | 21.89 | | | | UU | 0.89 | 4 | |
| 198.890 | 4.30 | SPT | | 24 | 18 | 58 | | | | | | | | | | |
| 197.540 | 5.65 | SPT | | | | | | | | | | | | | | |
| 196.690 | 6.50 | UDS | | | | | | | | | | | | | | |
| 196.040 | 7.15 | SPT | Sandy Silt With Gravel (SM-ML) | | | | | | | | | | | | | |
| 194.390 | 8.80 | SPT | | | | | | | | | | | | | | |
| 192.890 | 10.30 | SPT | Refusal Strata | | | | | | | | | | | | | |

S.P.T Plot — Observed




TENDER NO PSER:SCT:NBN-C2067:20

# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Co-Ordinates: 180E, 1957S

Job No: 1930

Location: Space for FGD II  BH No. : 54  DEPTH : 45.00 m  Depth of Water Table :5.25 m

Date of Start : 02/01/2012  Date of Finish : 10/01/2012

| REDUCED LEVEL | DEPTH | LITHOLOGY DESCRIPTION | LOG | Size of core pieces | STRUCTURAL CONDITIONS DESCRIPTION | PERCENT CORE RECOVERY | RQD | SIZE OF HOLE | GROUT | CASING OTHER SIZES | DEPTH OF WATER LEVEL | WATER LOSS | PERCOLATION TEST | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 193.190 | 10.00 | Highly weathered disintegrated Rock | | | | | | | | | | | | | CR(CM)=Nil<br>CR(%)=Nil<br>RQD(%)=Nil N>100 |
| 191.690 | 11.50 | | | | | | | | | | | | | | |
| 190.690 | 12.50 | Highly weathered highly fractured Limestone | | | | | | NX | | | | | | | CR(CM)=49<br>CR(%)=33<br>RQD(%)=Nil N>100 |
| 189.190 | 14.00 | | | | | | | | | | | | | | CR(CM)=32<br>CR(%)=21<br>RQD(%)=Nil N>100 |
| 187.690 | 15.50 | | | | | | | NX | | | | | | | CR(CM)=21<br>CR(%)=14<br>RQD(%)=Nil N>100 |
| 186.190 | 17.00 | | | | | | | | | | | | | | CR(CM)=30<br>CR(%)=20<br>RQD(%)=Nil N>100 |
| 184.690 | 18.50 | | | | | | | | | | | | | | CR(CM)=32<br>CR(%)=21<br>RQD(%)=Nil N>100 |
| 183.190 | 20.00 | | | | | | | NX | | | | | | | CR(CM)=14<br>CR(%)=9<br>RQD(%)=Nil N>100 |
| 181.690 | 21.50 | | | | | | | | | | | | | | CR(CM)=31<br>CR(%)=20<br>RQD(%)=Nil N>100 |
| 180.690 | 22.50 | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# BORE LOG

**PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.**

BH No.: 55
Depth : 37.50 m
Depth of Water table : 3.10 m

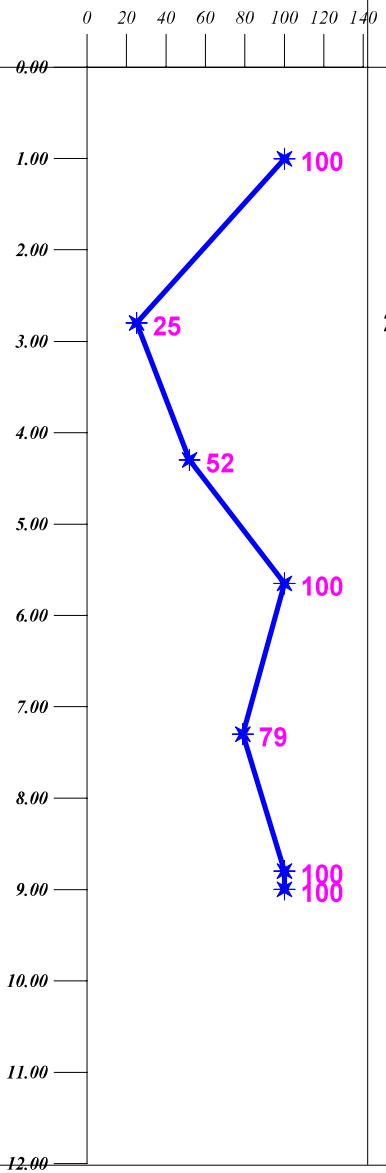
RL 202.775

Date of start : 12/02/2012
Date of finish : 18/02/2012

**Project No. 1930** Location: Space for FGD II Co-Ordinates: 205E, 1965S

| Reduced Level | Depth (m) | Type of sample | Soil Classification | Gravel | Sand | Silt/Clay | r(wet) | r(dry) | W(%) | L.L | P . L | Sp.Gr | Shear Parameters: Type of test | C(kg/sq.cm) | phi(degrees) | Cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 202.775 | 0.00 | | | | | | | | | | | | | | | |
| 201.775 | 1.00 | SPT | | | | | | | | Non Plastic | | | | | | |
| 199.975 | 2.80 | SPT | | 20 | 13 | 67 | | | | Non Plastic | | | | | | |
| 199.275 | 3.50 | UDS | Sandy Silt with Gravel (SM-ML) | | | | | | | | | | | | | |
| 198.475 | 4.30 | SPT | | | | | | | | Non Plastic | | | | | | |
| 197.125 | 5.65 | SPT | | | | | | | | Non Plastic | | | | | | |
| 195.475 | 7.30 | SPT | | | | | | | | Non Plastic | | | | | | |
| 193.975 | 8.80 | SPT | | 4 | 17 | 79 | | | | Non Plastic | | | | | | |
| 193.775 | 9.00 | SPT | Refusal Strata | | | | | | | Non Plastic | | | | | | |

S.P.T Plot — Observed




TENDER NO PSER:SCT:NBN-C2067:20

# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Co-Ordinates: 205E, 1965S

Job No: 1930

Location: Space for FGD II  BH No.: 55  DEPTH : 37.50 m  Depth of Water Table : 3.10 m

Date of Start : 12/02/2012  Date of Finish : 18/02/2012

| REDUCED LEVEL | DEPTH | LITHOLOGY: DESCRIPTION | LOG | Size of core pieces: < 10 mm size / 10 to 25 mm / 25 to 75 mm / 75 to 150 mm / > 150 mm | STRUCTURAL CONDITIONS: DESCRIPTION | PERCENT CORE RECOVERY (0 20 40 60 80 100) | RQD (0 20 40 60 80 100) | SIZE OF HOLE | GROUT | CASING: OTHER SIZES (mmNX BX AX) | DEPTH OF WATER LEVEL | WATER LOSS (NO / PARTIAL / COMPLETE; 0 20 40 60 80 100) | PERCOLATION TEST: TEST SECTION | BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) | BY APPLIED PRESSURE METHOD: LOSS(l/m) | BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL | BY FALLING HEAD METHOD: TIME INTERVAL | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 193.775 | 9.00 | Highly weathered disintegrated Rock | | | | | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 192.775 | 10.00 | Highly weathered highly fractured Limestone | | | | | | | | | | | | | | | | | CR(CM)=42 CR(%)=42 RQD(%)=Nil N>100 |
| 191.775 | 11.00 | Highly weathered disintegrated Rock | | | | | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 190.775 | 12.00 | Highly weathered highly fractured greyish to pinkish color Limestone | | | | | | NX | | | | | | | | | | | CR(CM)=34 CR(%)=23 RQD(%)=Nil N>100 |
| 189.275 | 13.50 | | | | | | | | | | | | | | | | | | CR(CM)=15 CR(%)=10 RQD(%)=Nil N>100 |
| 187.775 | 15.00 | | | | | | | NX | | | | | | | | | | | CR(CM)=26 CR(%)=17 RQD(%)=Nil N>100 |
| 186.275 | 16.50 | Highly weathered disintegrated Rock | | | | | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 184.775 | 18.00 | Highly weathered highly fractured greyish to pinkish color Limestone | | | | | | | | | | | | | | | | | CR(CM)=45 CR(%)=30 RQD(%)=17 N>100 |
| 183.275 | 19.50 | | | | | | | NX | | | | | | | | | | | CR(CM)=30 CR(%)=20 RQD(%)=Nil N>100 |
| 181.775 | 21.00 | | | | | | | | | | | | | | | | | | CR(CM)=16 CR(%)=11 RQD(%)=Nil N>100 |
| 180.275 | 22.50 | | | | | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# BORE LOG

**PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.**

BH No.: 57
Depth : 25.00 m
Depth of Water table : 9.00 m

RL: 202.097

Date of start : 04/03/2012
Date of finish : 09/03/2012

**Project No. 1930** Location: Space for FGD II Co-Ordinates: 283E, 1956S

| Reduced Level | Depth (m) | Type of sample | Soil Classification | S.P.T Plot (Observed) | Gravel | Sand | Silt/Clay | r(wet) | r(dry) | W(%) | L.L | P . L | Sp.Gr | Shear Parameters: Type of test | C(kg/sq.cm) | phi(degrees) | Cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 202.097 | 0.00 | | | | | | | | | | | | | | | | |
| 200.797 | 1.30 | SPT | | 13 | 25 | 17 | 58 | | | | 38 | 20 | | | | | |
| 199.297 | 2.80 | SPT | Silty Clay of medium Plasticity (CI) | 16 | | | | | | | | | | | | | |
| 198.597 | 3.50 | UDS | | | | | | 1.86 | 1.57 | 18.11 | | | 2.74 | UU | 0.84 | 3 | 0.061 |
| 197.797 | 4.30 | SPT | | 57 | | | | | | | | | | | | | |
| 196.447 | 5.65 | SPT | | 100 | 12 | 22 | 66 | | | | | | | | | | |
| 195.097 | 7.00 | SPT | Sandy Silt with Gravel (SM-ML) | 100 | | | | | | | | | | | | | |
| 193.447 | 8.65 | SPT | | 100 | | | | | | | | | | | | | |
| 193.097 | 9.00 | SPT | | 100 | | | | | | | | | | | | | |
| | | | Refusal Strata | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Co-Ordinates: 283E, 1956S

Job No: 1930

Location: Space for FGD II BH No.: 57 DEPTH : 25.00 m Depth of Water Table : 9.00 m

Date of Start : 04/03/2012 Date of Finish : 09/03/2012

| REDUCED LEVEL | DEPTH | LITHOLOGY DESCRIPTION | LOG | Size of core pieces | STRUCTURAL CONDITIONS DESCRIPTION | PERCENT CORE RECOVERY | RQD | SIZE OF HOLE | GROUT | CASING OTHER SIZES | DEPTH OF WATER LEVEL | WATER LOSS | PERCOLATION TEST | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 193.097 | 9.00 | Highly weathered disintegrated Rock | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 191.597 | 10.50 | Highly weathered highly fractured Rock | | | | | | | | | | | | | CR(CM)=30 CR(%)=20 RQD(%)=Nil N>100 |
| 190.097 | 12.00 | | | | | | | NX | | | | | | | CR(CM)=9 CR(%)=6 RQD(%)=Nil N>100 |
| 188.597 | 13.50 | | | | | | | | | | | | | | CR(CM)=30 CR(%)=20 RQD(%)=Nil N>100 |
| 187.097 | 15.00 | Highly weathered disintegrated Rock | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 185.597 | 16.50 | Highly weathered highly fractured Rock | | | | | | NX | | | | | | | CR(CM)=21 CR(%)=14 RQD(%)=Nil N>100 |
| 184.097 | 18.00 | Highly weathered disintegrated Rock | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 182.597 | 19.50 | Highly weathered highly fractured Rock | | | | | | | | | | | | | CR(CM)=15 CR(%)=10 RQD(%)=Nil N>100 |
| 181.097 | 21.00 | Highly weathered disintegrated Rock | | | | | | NX | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 179.597 | 22.50 | Highly weathered highly fractured Rock | | | | | | | | | | | | | CR(CM)=19 CR(%)=13 RQD(%)=Nil N>100 |
| 178.097 | 24.00 | | | | | | | | | | | | | | CR(CM)=12 CR(%)=12 RQD(%)=Nil N>100 |
| 177.097 | 25.00 | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# BORE LOG

**PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.**

BH No.: 58
Depth : 25.00 m
Depth of Water table : 7.80 m

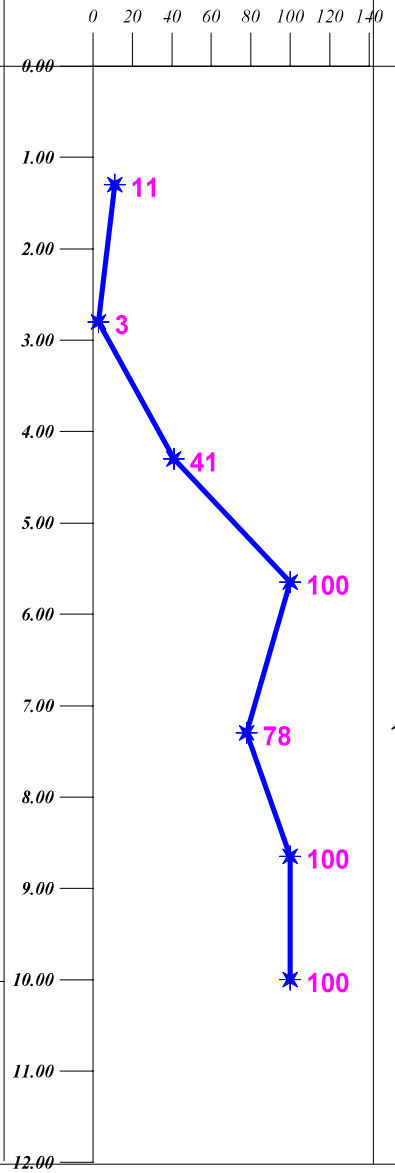
RL: 202.350

Date of start : 05/03/2012
Date of finish : 15/03/2012

**Project No. 1930** Location: Space for FGD II Co-Ordinates: 257E, 1990S

| Reduced Level | Depth (m) | Type of sample | Soil Classification | Gravel | Sand | Silt/Clay | r(wet) | r(dry) | W(%) | L.L | P . L | Sp.Gr | Type of test | C(kg/sq.cm) | phi(degrees) | Cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 202.350 | 0.00 | | | | | | | | | | | | | | | |
| 201.050 | 1.30 | SPT | | | | | | | | | | | | | | |
| 199.550 | 2.80 | SPT | | 8 | 11 | 81 | | | | | | | | | | |
| 198.850 | 3.50 | UDS | | | | | | | | | | | | | | |
| 198.050 | 4.30 | SPT | Silty Clay of medium Plasticity (CI) | | | | | | | | | | | | | |
| 196.700 | 5.65 | SPT | | | | | | | | | | | | | | |
| 195.050 | 7.30 | SPT | | 13 | 22 | 65 | | | | 39 | 22 | | | | | |
| 193.700 | 8.65 | SPT | | | | | | | | | | | | | | |
| 192.350 | 10.00 | SPT | Refusal Strata | | | | | | | | | | | | | |

S.P.T Plot — Observed




TENDER NO PSER:SCT:NBN-C2067:20

# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Co-Ordinates: 257E, 1990S

Job No: 1930

Location: Space for FGD II  BH No.: 58  DEPTH : 25.00 m  Depth of Water Table : 7.80 m

Date of Start : 05/03/2012  Date of Finish : 15/03/2012

| REDUCED LEVEL | DEPTH | LITHOLOGY: DESCRIPTION | LOG | Size of core pieces: < 10 mm size | 10 to 25 mm | 25 to 75 mm | 75 to 150 mm | > 150 mm | STRUCTURAL CONDITIONS: DESCRIPTION | PERCENT CORE RECOVERY (0 20 40 60 80 100) | RQD (0 20 40 60 80 100) | SIZE OF HOLE | GROUT | CASING: OTHER SIZES (mmNX BX AX) | DEPTH OF WATER LEVEL | WATER LOSS (NO / PARTIAL / COMPLETE; 0 20 40 60 80 100) | PERCOLATION TEST: TEST SECTION | BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) | BY APPLIED PRESSURE METHOD: LOSS(l/m) | BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL | BY FALLING HEAD METHOD: TIME INTERVAL | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 191.850 | 10.50 | Highly weathered disintegrated Rock | | | | | | | | | | NX | | | | | | | | | | | CR(CM)=Nil<br>CR(%)=Nil<br>RQD(%)=Nil N>100 |
| 190.350 | 12.00 | | | | | | | | | | | | | | | | | | | | | | |
| 188.850 | 13.50 | | | | | | | | | | | | | | | | | | | | | | |
| 187.350 | 15.00 | | | | | | | | | | | | | | | | | | | | | | |
| 185.850 | 16.50 | | | | | | | | | | | | | | | | | | | | | | |
| 184.350 | 18.00 | | | | | | | | | | | NX | | | | | | | | | | | |
| 182.850 | 19.50 | | | | | | | | | | | | | | | | | | | | | | CR(CM)=11<br>CR(%)=7<br>RQD(%)=Nil N>100 |
| 181.350 | 21.00 | Highly weathered highly fractured Rock | | | | | | | | | | | | | | | | | | | | | CR(CM)=12<br>CR(%)=8<br>RQD(%)=Nil N>100 |
| 179.850 | 22.50 | | | | | | | | | | | NX | | | | | | | | | | | CR(CM)=20<br>CR(%)=13<br>RQD(%)=Nil N>100 |
| 178.350 | 24.00 | | | | | | | | | | | | | | | | | | | | | | CR(CM)=6<br>CR(%)=6<br>RQD(%)=Nil N>100 |
| 177.350 | 25.00 | | | | | | | | | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# BORE LOG

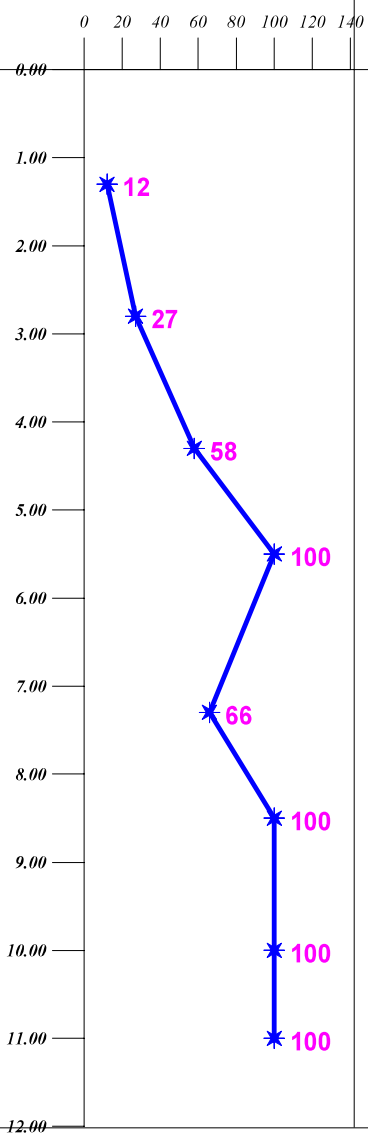
**PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.**

BH No.: 60
Depth : 35.00 m
Depth of Water table : 11.70 m

RL: 203.745

Date of start : 23/02/2012
Date of finish : 27/02/2012

**Project No. 1930** Location:Space for FGD I Co-Ordinates: 100E, 1991S




| Reduced Level | Depth (m) | Type of sample | Soil Classification | Grain size (%) Gravel | Sand | Silt/Clay | Density (gm/cc) r(wet) | r(dry) | W/C W(%) | Limits (%) L.L | P . L | Sp.Gr | Shear Parameters Type of test | C(kg/sq.cm) | phi(degrees) | Cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 203.745 | 0.00 | | | | | | | | | | | | | | | |
| 202.445 | 1.30 | SPT | | | | | | | | | | | | | | |
| 200.945 | 2.80 | SPT | | | | | | | | | | | | | | |
| 199.445 | 4.30 | SPT | | | | | | | | | | | | | | |
| 198.245 | 5.50 | SPT | Sandy Silt with Gravel (SM-ML) | | | | | | | | | | | | | |
| 196.445 | 7.30 | SPT | | 15 | 19 | 66 | | | | Non Plastic | | | | | | |
| 195.245 | 8.50 | SPT | | | | | | | | | | | | | | |
| 193.745 | 10.00 | SPT | | | | | | | | | | | | | | |
| 192.745 | 11.00 | SPT | Refusal Strata | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Co-Ordinates: 100E, 1991S

Job No: 1930

Location: Space for FGD I  BH No.: 60  DEPTH : 35.00 m  Depth of Water Table : 11.70 m

Date of Start : 23/02/2012  Date of Finish : 27/02/2012

| REDUCED LEVEL | DEPTH | LITHOLOGY DESCRIPTION | LOG | Size of core pieces | STRUCTURAL CONDITIONS DESCRIPTION | PERCENT CORE RECOVERY | RQD | SIZE OF HOLE | GROUT | CASING OTHER SIZES | DEPTH OF WATER LEVEL | WATER LOSS | PERCOLATION TEST: TEST SECTION | PERCOLATION TEST: BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) | PERCOLATION TEST: BY APPLIED PRESSURE METHOD: LOSS(l/m) | PERCOLATION TEST: BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL | PERCOLATION TEST: BY FALLING HEAD METHOD: TIME INTERVAL | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 192.745 | 11.00 | | | | | | | | | | | | | | | | | | |
| 191.245 | 12.50 | Highly weathered Disintgrated Rock | | | | | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 189.745 | 14.00 | | | | | | | | | | | | | | | | | | CR(CM)=6 CR(%)=4 RQD(%)=Nil N>100 |
| 188.245 | 15.50 | | | | | | | | | | | | | | | | | | CR(CM)=11 CR(%)=7 RQD(%)=Nil N>100 |
| 186.745 | 17.00 | | | | | | | NX | | | | | | | | | | | CR(CM)=43 CR(%)=29 RQD(%)=Nil N>100 |
| 185.245 | 18.50 | | | | | | | | | | | | | | | | | | CR(CM)=32 CR(%)=21 RQD(%)=Nil N>100 |
| 183.745 | 20.00 | Highly weathered highly fractured Limestone | | | | | | | | | | | | | | | | | CR(CM)=36 CR(%)=24 RQD(%)=Nil N>100 |
| 182.245 | 21.50 | | | | | | | | | | | | | | | | | | CR(CM)=33 CR(%)=22 RQD(%)=Nil N>100 |
| 180.745 | 23.00 | | | | | | | NX | | | | | | | | | | | CR(CM)=44 CR(%)=29 RQD(%)=Nil N>100 |
| 179.245 | 24.50 | | | | | | | | | | | | | | | | | | CR(CM)=41 CR(%)=27 RQD(%)=Nil N>100 |
| 177.745 | 26.00 | | | | | | | | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 176.245 | 27.50 | | | | | | | | | | | | | | | | | | |
| 174.745 | 29.00 | Highly weathered Disintgrated Rock | | | | | | | | | | | | | | | | | CR(CM)=9 CR(%)=6 RQD(%)=Nil N>100 |
| 173.245 | 30.50 | | | | | | | NX | | | | | | | | | | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 171.745 | 32.00 | | | | | | | | | | | | | | | | | | CR(CM)=23 CR(%)=15 RQD(%)=Nil N>100 |
| 170.245 | 33.50 | Highly weathered highly fractured Limestone | | | | | | | | | | | | | | | | | CR(CM)=16 CR(%)=11 RQD(%)=Nil N>100 |
| 168.745 | 35.00 | | | | | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# BORE LOG

**PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.**

**BH No.: 163** RL:205.187 Date of start : 05/03/2013
**Depth : 30.00 m** Date of finish : 09/03/2013
**Depth of Water table : 14.00 m**

**Project No. 1930** Space for FGD I Co-Ordinates: 2E, 1982S

| Reduced Level | Depth (m) | Type of sample | Soil Classification | S.P.T Plot (Observed) | Gravel | Sand | Silt/Clay | Density (gm/cc) r(wet) | Density (gm/cc) r(dry) | W/C W(%) | Limits (%) L.L | Limits (%) P . L | Sp.Gr | Shear Parameters Type of test | Shear Parameters C(kg/sq.cm) | Shear Parameters phi(degrees) | Cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 205.187 | 0.00 | | | 0.00 | | | | | | | | | | | | | |
| 203.887 | 1.30 | SPT | Silty Clay of low to medium Plasticity (CL-CI) | 26 | 25 | 23 | 52 | | | | 30 | 18 | | | | | |
| 202.387 | 2.80 | SPT | | 21 | 15 | 17 | 68 | | | | | | | | | | |
| 201.687 | 3.50 | UDS | | | | | | 1.84 | 1.63 | 12.86 | | | 2.76 | UU | 1.08 | 5 | |
| 200.887 | 4.30 | SPT | | 22 | 1 | 7 | 92 | | | | 40 | 25 | | | | | |
| 199.387 | 5.80 | SPT | | 30 | 2 | 7 | 91 | | | | | | | | | | |
| 198.687 | 6.50 | UDS | | | | | | 1.86 | 1.64 | 13.45 | | | 2.78 | UU | 1.12 | 5 | |
| 197.887 | 7.30 | SPT | Sandy Silt with gravel (Sm-ML) | 21 | 3 | 23 | 74 | | | | Non | Plastic | | | | | |
| 196.387 | 8.80 | SPT | | 26 | 19 | 12 | 69 | | | | Non | Plastic | | | | | |
| 194.887 | 10.30 | SPT | | 59 | 3 | 9 | 88 | | | | Non | Plastic | | | | | |
| 193.387 | 11.80 | SPT | Silty Clay of low to medium Plasticity (CL-CI) | 56 | 10 | 24 | 66 | | | | 33 | 21 | | | | | |
| 192.687 | 12.50 | UDS | | | | | | 2.16 | 1.80 | 19.85 | | | 2.76 | UU | 2.98 | 3 | |
| 191.887 | 13.30 | SPT | | 56 | 3 | 13 | 84 | | | | | | | | | | |
| 190.387 | 14.80 | SPT | | 67 | 9 | 11 | 80 | | | | 37 | 25 | | | | | |
| 188.887 | 16.30 | SPT | | 67 | 8 | 12 | 80 | | | | | | | | | | |
| 187.387 | 17.80 | SPT | | 57 | 10 | 16 | 74 | | | | | | | | | | |
| 185.887 | 19.30 | SPT | Sandy Silt with gravel (Sm-ML) | 66 | 18 | 18 | 64 | | | | Non | Plastic | | | | | |
| 185.187 | 20.00 | SPT | Refusal Strata | 100 | 15 | 34 | 51 | | | | Non | Plastic | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Job No: 1930

Location : Space for FGD I  BH No. : 163  DEPTH :30.00 m  Depth of Water Table : 14.00 m  Date of Start : 05/03/2013  Date of Finish : 09/03/2013

| REDUCED LEVEL | DEPTH | LITHOLOGY: DESCRIPTION | LOG | Size of core pieces: < 10 mm size | 10 to 25 mm | 25 to 75 mm | 75 to 150 mm | > 150 mm | STRUCTURAL CONDITIONS: DESCRIPTION | PERCENT CORE RECOVERY | RQD | SIZE OF HOLE | GROUT | CASING: OTHER SIZES | DEPTH OF WATER LEVEL | WATER LOSS | PERCOLATION TEST: TEST SECTION | BY APPLIED PRESSURE METHOD: PRESSURE (kg/sq.cm) | LOSS(l/m) | BY FALLING HEAD METHOD: DEPTH OF WATER LEVEL | TIME INTERVAL | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 185.187 | 20.00 | Highly weathered disintegrated Rock | | | | | | | | | | | | | | | | | | | | | CR(CM)=Nil<br>CR(%)=Nil<br>RQD(%)=Nil N>100 |
| 184.187 | 21.00 | | | | | | | | | | Nil | | | | | | | | | | | | CR(CM)=18<br>CR(%)=12<br>RQD(%)=Nil N>100 |
| 182.687 | 22.50 | | | | | | | | | | | NX | | | | | | | | | | | CR(CM)=13<br>CR(%)=9<br>RQD(%)=Nil N>100 |
| 181.187 | 24.00 | | | | | | | | | | | | | | | | | | | | | | CR(CM)=15<br>CR(%)=10<br>RQD(%)=Nil N>100 |
| 179.687 | 25.50 | Highly weathered and fractured reddish Color Limestone | | | | | | | | | | | | | | | | | | | | | CR(CM)=19<br>CR(%)=13<br>RQD(%)=Nil N>100 |
| 178.187 | 27.00 | | | | | | | | | | | | | | | | | | | | | | CR(CM)=14<br>CR(%)=9<br>RQD(%)=Nil N>100 |
| 176.687 | 28.50 | | | | | | | | | | Nil | | | | | | | | | | | | CR(CM)=20<br>CR(%)=13<br>RQD(%)=Nil N>100 |
| 175.187 | 30.00 | | | | | | | | | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# BORE LOG

**PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.**

**BH No.: 164** RL:203.732 Date of start : 09/03/2013

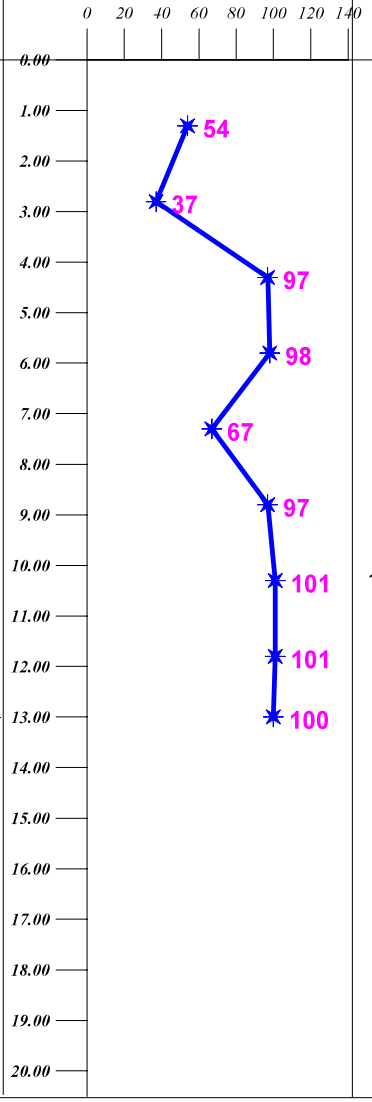
**Depth : 35.00 m**

**Depth of Water table : 14.70 m** Date of finish : 14/03/2013

**Project No. 1930** CHIMNEY Co-Ordinates: 141E, 1918S

| Reduced Level | Depth (m) | Type of sample | Soil Classification | Grain size (%) Gravel | Sand | Silt/Clay | Density (gm/cc) r(wet) | r(dry) | W/C W(%) | Limits (%) L.L | P . L | Sp.Gr | Shear Parameters Type of test | C(kg/sq.cm) | phi(degrees) | Cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 203.732 | 0.00 | | | | | | | | | | | | | | | |
| 202.432 | 1.30 | SPT | | 5 | 5 | 90 | | | | Non | Plastic | | | | | |
| 200.932 | 2.80 | SPT | | 1 | 15 | 84 | | | | Non | Plastic | | | | | |
| 200.232 | 3.50 | UDS | | | | | 1.91 | 1.67 | 14.64 | | | 2.65 | DST | 0.12 | 32 | |
| 199.432 | 4.30 | SPT | | 4 | 7 | 89 | | | | Non | Plastic | | | | | |
| 197.932 | 5.80 | SPT | Sandy Silt with gravel (SM-ML) | 1 | 24 | 75 | | | | Non | Plastic | | | | | |
| 196.432 | 7.30 | SPT | | 3 | 10 | 87 | | | | Non | Plastic | | | | | |
| 194.932 | 8.80 | SPT | | 3 | 13 | 84 | | | | Non | Plastic | | | | | |
| 193.432 | 10.30 | SPT | | 16 | 14 | 70 | | | | Non | Plastic | | | | | |
| 191.932 | 11.80 | SPT | | 8 | 16 | 76 | | | | Non | Plastic | | | | | |
| 190.732 | 13.00 | SPT | | 2 | 12 | 86 | | | | Non | Plastic | | | | | |
| | | | Refusal Strata | | | | | | | | | | | | | |

S.P.T Plot — Observed



# SOIL ENGINEERING CONSULTANTS

***PROJECT: Geotechnical Investigation work for the proposed Super Thermal Power Project at Lara, Raigarh, CH.***

Job No: 1930

Location : CHIMNEY  BH No. : 164  DEPTH :35.00 m  Depth of Water Table : 14.700 m  Date of Start : 09/03/2013  Date of Finish : 14/03/2013

| REDUCED LEVEL | DEPTH | LITHOLOGY DESCRIPTION | LOG | Size of core pieces | STRUCTURAL CONDITIONS DESCRIPTION | PERCENT CORE RECOVERY | RQD | SIZE OF HOLE | GROUT | CASING OTHER SIZES | DEPTH OF WATER LEVEL | WATER LOSS | PERCOLATION TEST | PERMEABILITY | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 190.732 | 13.00 | Highly weathered disintegrated Rock | | < 10 mm size, 10 to 25 mm, 25 to 75 mm, 75 to 150 mm, > 150 mm | | 0 20 40 60 80 100 | 0 20 40 60 80 100 | | | mmNX BX AX | | NO PARTIAL COMPLETE | TEST SECTION; BY APPLIED PRESSURE METHOD (PRESSURE (kg/sq.cm), LOSS(l/m)); BY FALLING HEAD METHOD (DEPTH OF WATER LEVEL, TIME INTERVAL) | | CR(CM)=Nil CR(%)=Nil RQD(%)=Nil N>100 |
| 189.232 | 14.50 | | | | | | | | | | | | | | |
| 187.732 | 16.00 | Highly weathered Highly fractured reddish Color Limestone | | | | | Nil | | | | | | | | CR(CM)=9,CR(%)=6 RQD(%)=Nil N>100 |
| 186.232 | 17.50 | | | | | | | | | | | | | | CR(CM)=12,CR(%)=8 RQD(%)=Nil N>100 |
| 184.732 | 19.00 | | | | | | | NX | | | | | | | CR(CM)=39CR(%)=26 RQD(%)=9 N>100 |
| 183.232 | 20.50 | Highly weathered and fractured reddish Color Limestone | | | | | | | | | | | | | CR(CM)=33,CR(%)=24 RQD(%)=9 N>100 |
| 181.732 | 22.00 | | | | | | | | | | | | | | CR(CM)=33,CR(%)=22 RQD(%)=9 N>100 |
| 180.232 | 23.50 | | | | | | | | | | | | | | CR(CM)=21,CR(%)=14 RQD(%)=Nil N>100 |
| 178.732 | 25.00 | | | | | | | | | | | | | | CR(CM)=15,CR(%)=10 RQD(%)=Nil N>100 |
| 177.232 | 26.50 | Highly weathered Highly fractured reddish Color Limestone | | | | | | | | | | | | | CR(CM)=26,CR(%)=18 RQD(%)=Nil N>100 |
| 175.732 | 28.00 | | | | | | | | | | | | | | |
| 174.232 | 29.50 | | | | | | | | | | | | | | CR(CM)=15,CR(%)=10 RQD(%)=Nil N>100 |
| 172.732 | 31.00 | | | | | | | | | | | | | | CR(CM)=21,CR(%)=14 RQD(%)=Nil N>100 |
| 171.232 | 32.50 | | | | | | | | | | | | | | CR(CM)=12,CR(%)=8 RQD(%)=Nil N>100 |
| 169.732 | 34.00 | | | | | | | | | | | | | | CR(CM)=12,CR(%)=12 RQD(%)=Nil N>100 |
| 168.732 | 35.00 | | | | | | | | | | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 1. | VI/A | III-C | 80 of 209 | 2.01.00 (c) | However, for vibration measurements and protection minimum 2 number (X and Y direction) sensors per bearing shall be provided. | Kindly confirm whether Vibration Monitoring System (VMS) is in the scope of this project?<br>If yes, kindly provide the Detailed specification for VMS. | Vibration Monitoring System (VMS) is not the scope of the bidder.<br><br>However, vibration measurement is envisaged for each vibration measurement point as indicated in<br>a)Tender drawing "0011-109-POM-A-001"<br>b) PART A, Clause 23.01.00 of sub section III-A1<br>c) PART-A, Clause 2.01.06 of sub section III-A5.<br><br>It is further clarified that as per clause 1.07.00 of sub section III-C2 PART B of technical specification, vibration measuring instrumentation shall be as per the standard and proven practice of the bidder. Vibration measuring instrumentation output (4-20mA) shall be connected to FGD control system instead of vibration monitoring system. |
| 2. | VI/A | III-C | 82 of 209 | 2.06.01 | Contractor shall depute Technical Experts of the OAM /OEM/OES/ (Original Analyser Manufactur- | We presume that the CEMS Equipment supplier (OAM/OEM/OES/System integrator | Bidder's understanding is correct. However, as envisaged in the specification clause 2.06.01, **technical** |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | er/Original Equipment Manufacturer/Original Equipment supplier) for each of the above system at Site, who will be fully qualified to perform the required duties, supervision of maintenance, repair etc. for a period of six month | etc.) is eligible for delivering the services of Comprehensive AMC (CAMC).<br>Kindly confirm. | **expert** of Original Analyser Manufacturer/Original Equipment Manufacturer/Original Equipment supplier, fully qualified to perform the required duties, supervision of maintenance, repair etc. for supplied systems, shall be deputed to site for delivering the services of Comprehensive AMC (CAMC). |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 3. | VI/A<br><br>VI/E | III-C<br><br>B (Control & Instrumentation | 84 of 209<br><br>13 of 53 | 6.05.00<br><br>Drawing No. 0000-151-POI-A-013 | The minimum **quantity per unit of furniture** envisaged in FGD control room is as mentioned below:<br><br>Standard Configuration Diagram for PLC based Offsite Control systems | As per the description given in the specification, there is only one FGD Control room common for all the Units.<br>We presume the quantity of furniture indicated in this clause is common for all the Units.<br><br>Kindly clarify and confirm. | Bidder's understanding is not correct.<br>Bidder to supply minimum quantity of furniture as mentioned in the specification on **per generating unit basis**. For example: In case of MOUDA-II (2x660MW) project, the quantity of furniture to be supplied shall be twice of the furniture quantity that is mentioned under clause 6.05.00 a) to e), Part-A, Sub Section III-C of the specification. Bidder shall comply with the specification. |
| 4. | VI/A | III-C | 84 of 209 | 6.03.00 | For each equipment/drives/pumps where Local Operation is envisaged in addition to control system as mentioned in respective Mechanical Sections, Bidder to consider Local Push button station comprising following: | We understand no separate hardwired back up consoles are required in FGD control room. The entire operation in FGD control room shall be through DCS/HMI.<br>Kindly confirm. | Bidder's understanding is correct. However, bidder to refer the relevant clauses of specification where equipment/drives/pumps for which Local Operation is envisaged has been mentioned. Bidder to provide local push button stations accordingly. |
| 5. | VI/A | III-C | 85, 86 of 209 | 9.01.00 | Hardwired Signal exchange: Hardwired signal exchange betv.'een BOP ODCMIS (under Employer's scope) and FGD PLC (under Contractor's scope) like.... | Kindly provide the Tentative route length distance between the following:<br>(i) RIO Panel and employer DCS.<br>(ii) RIO Panel and 24 V DC feeder | It is clarified that<br>i) RIO panel and employer's DCS are placed at the same location i.e. Central Equipment Room (CER). Tentative route length be- |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | Contractor shall provide Remote Input Output (RIO) for PLC per unit, placed in Central Equipment Room (CER) for the same. However, contractor to consider IDs and cables for minimum number of hardwired signal exchange per unit as follows 01 - 80, DO - 80, AI - 20 and AD - 20. NTPC shall provide 2 (Two) nos. of 24V DC power supply feeders in CER for powering RIO panel. | (Customer provided)<br>(iii) FGD RIO Panel & FGD Control room for all the projects.<br><br>Also modification and changes required at the Customer's DCS end/station LAN for FGD interface is also not in the scope of the Bidder. Kindly confirm. | tween RIO panel (Placed in CER) and employer's DCS shall be 200 meters approximately for all projects.<br>ii) Tentative route length between RIO panel (Placed in CER) and 24 V DC feeder (NTPC scope) shall be 200 meters approximately for all projects.<br>iii) For route length between FGD RIO panel (placed in CER) and FGD control room, bidder to refer clause 9.03.00, PART-A, Sub Section III-C, wherein it is mentioned that "Bidder to visit site to estimate the distance between FGD control room and Employer's CCR/CER". Other FGD RIO panel location shall be finalized during detailed engineering<br><br>Bidder's understanding is correct that modification and changes required at the Customer's DCS end/station LAN for FGD interface is not in the scope of the bidder. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 6. | VI/A | VII | 197of 209 | 1.07.03 | MANDATORY SPARES:<br>1.07.00 PLC CONTROLS SYSTEM<br>1.07.03 CENTRAL PROCESSOR UNIT: | Kindly clarify what is Central processing Unit, does it mean the controller module of the DCS system? Kindly confirm. | Bidder's understanding is correct. |
| 7. | VI/B | III-C1 | 6 of 103 | 3.04.00 | Bidder shall be required to ensure supply of spare parts for lifetime of the plant. In case, the Bidder feels that certain equipment/component is likely to become obsolete, the Bidder shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence. | Normally Electronic cards/module phased out in 8-10 years due to continuous up-gradation in technology, hence we request Customer to suitably modify the given clause as given below:<br><br>*"Bidder shall ensure availability of Spares for 10 years. Beyond this period, in case of phasing out of production of spares parts, a notice of 12 months in advance regarding this shall be provided to Owner in order to enable them to order & stock bulk requirement of spares.* | With reference to clause 3.04.00, Part-B, Sub Section III-C1 of technical specification, it is clarified that lifetime of the plant is envisaged as 15 years for which bidder shall ensure supply of the spare parts. Bidder shall comply with the specification. |
| 8. | VI/B | III-C4 | 55 & 56 of 103 | 5.00.00 | Marshalling/Marshalling cum Termination cubicle | Customer is requested to consider Cable termination at marshalling cabinet or any other equivalent methodology being followed by the | Bidder's proposal is not acceptable. Bidder shall comply with the specification. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | Notes:<br>4. For connection between field JB and DDCMIS marshalling cabinet | manufacturer for several projects in the past may also be permitted to be adopted in this project.<br>Kindly confirm. | |
| 9. | VI/B | III-C5 | 62 of 103 | PLC BASED CONTROL SYSTEM | PLC BASED CONTROL SYSTEM | Bidder's in-house manufactured DCS which is field proven in power plants gives the Customer following advantages:<br>(i) Better immunity to noise.<br>(ii) Scalable and Flexible system<br>(iii) Comprehensive Diagnostics<br>(iv) Centralised alarms, events and historian<br>(v) Faster inter communication<br>(vi) Unified Information Management,<br>(vii)Common engineering platform & Unified diagnostics,<br>(viii) Single family hardware solution, Reduction of hardwired interface or soft links,<br>(ix) Ergonomic and user friendly man-machine interface.<br>(x) Effective spares and inventory management.<br>(xi) Better response time.<br>(xii) Single window for future expan- | It is clarified that in addition to the specification requirements, bidder's proposal is also acceptable subject to:<br>i) Proposed DCS based control system for FGD fully meets functional requirements as mentioned in the specification.<br>ii) Proposed DCS based control system for FGD is as per bidder's standard and proven practice.<br>iii) The DCS based control system shall be reviewed and approved by employer during detailed engineering. |
| | VI-B | III-C5 | 63 of 103 | 1.04.00 | Contractor shall provide independent control systems for safe, efficient and reliable operation of each of the plant auxiliary systems. | | |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | | sion.<br>(xiii) Better Spares Management & Inventory reduction. etc.<br>(xiv) Supports renovation and modernization.<br><br>Hence Customer is requested to accept DCS based controls also for FGD. | |
| 10. | VI/B | III-C5 | 65 of 103 | 2.03.00 | All dynamic memories shall be provided with<br>buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type. | Bidder's in-house manufactured DCS has Flash EPROM for non-volatile configuration which does not require battery backup.<br>Customer is requested to consider this option. | Bidder's proposal is acceptable in view of bidder's proposal to supply DCS based control system for FGD. |
| 11. | VI/B | III-C6 | 91 of 103 | 1.01.01 (a) | Out of the tests listed, the Bidder/sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests. | As per the list given at clause no. 3.00.00 TYPE TEST REQUIREMENT FOR C&I SYSTEMS, there are no type tests mentioned to be specifically conducted for this contract under column 5. Kindly confirm that type test need not to be conducted specifically for this project and type test certificates are sufficient for each item to be supplied in this project. | Bidder's understanding is correct. Bidder to further refer clause 1.01.01 b), PART-B, Sub Section III-C6 wherein the acceptance criteria for type test certificates has been mentioned. Bidder shall comply with the above mentioned clause while submitting the type test certificates for NTPC approval. |

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|---|---|---|---|---|---|---|---|
| | Vol/SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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|---|---|---|---|---|---|---|---|
| | Vol/SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 12. | SEC-06 ,PART B | Sub sec.-II-E-10 | Pg. 2 of 58 | 1.03.00 | Spare capacity and future requirement<br>All LV switchboard shall be provided with spare feeders/modules as specified in relevant clause of PART –A of technical specification. | We have not found requirement of spare feeders anywhere in PART A of tech. specification..<br>In the absence of the requirement of spare feeders in the specification, we will supply 10% spare feeders as per below:-<br>a. Unidirectional and Bidirectional motor feeder: Spare feeders based on physical size of the module.<br>b. Supply feeders: Based on SFU/MCCB rating.<br>c. No spare breaker (ACB) feeder shall be provided except outgoing motor feeder.<br>d. No spare feeders shall be provided for Incomer/Bus coupler (non-ACB) modules | This clause is DELETED.<br><br>Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI) |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 13. | PART-A | III-A5 | 1 OF 6 | 1.01.00 | Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed Layout submitted with the bid | We understand any modification and relocation is not in the scope of this package. Please confirm | All required modification and demolition work of existing facilities shall be in the bidder's scope. However if any relocation of existing facility is required, the same shall be done by the employer. |
| 14. | PART-A | III-A5 | 2 OF 6 | 2.01.01 | Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed Layout submitted with the bid | Request customer to furnish the drawings of the existing facilities to study the modification required in the existing facility. | Bidder shall refer the GLP drawing attached with the tender documents and shall also visit the site to study existing facilities that require modification. |
| 15. | PART-B | IV-D | 23 OF 69 | 5.07.00 | Polycarbonate sheet of 3 mm thick.... | We propose to use 2 mm thick polycarbonate sheets. Please confirm. | Bidder shall comply with technical specification requirement |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | | | |
| 16. | PART-B | IV-D | 30 OF 69 | 11.00.00 | Fencing around lime storage/ gypsum storage area. | We do not understand the requirement of any fencing in these areas. Kindly review the requirement and confirm. | Refer Scope of work. Refer clause 2.00.00, Section-VI, Part-A of technical specification. |
| 17. | PART-B | IV-D | 8 OF 69 | 3.07.00 | Gypsum storage shed- Gypsum storage shed shall be of RCC –framed structure with steel structure framed structure----- | Details specified for gypsum storage shed is not clear. Please furnish the detail specification for the gypsum storage shed. We propose to use space frame structure with bolted joints. Please confirm. | Bidder to refer amendment in this regard. |
| 18. | PART-A | III-A5 | 3 0F6 | 2.01.07 | Crushed limestone reclaim hopper(RH silo)Machinery hatch--- | Please furnish the detail specification for the lime stone storage shed. We propose to use space frame structure with bolted joints. Please confirm. | Bidder to refer necessary amendment in this regard. |
| 19. | PART-A | III-A5 | 3 0F6 | 2.01.10 | Suitable no. of motorized travelling tripper /flow diverter----feeding the crushed limestone to limestone shed | We understand that intermediate supporting trestle can be provided for the supporting of tripper conveyor gallery inside lime stone shed. Please confirm. | Confirmed. However adequate space for movement of dozer/payloader shall be provided. |
| 20. | PART-A | III-A5 | 60F6 | 3.06.00 | Suitable no. of motorized travelling tripper /flow divert- | We understand that intermediate supporting trestle can be provided | Confirmed. However adequate space for movement of doz- |

# CLARIFICATION No.01 (TECHNICAL)
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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | er----feeding the gypsum to gypsum shed. | for the supporting of tripper conveyor gallery inside gypsum shed. Please confirm. | er/payloader shall be provided. |
| 21. | PART-B | IV-D | 8 OF 69 | 3.07.00 | Gypsum storage shed- Gypsum storage shed shall be of RCC –framed structure with steel structure framed structure----- | We understand that for the gypsum stock pile area no PCC/RCC paving is required. Only leveling and grading of gypsum stockpile area is needed. | Bidder to refer amendment in this regard. |
| 22. | PART-A | III-A5 | 3 0F6 | 2.01.07 | Crushed limestone reclaim hopper(RH silo)Machinery hatch--- | We understand that no retaining wall and peripheral drain needed around lime stone stock pile and gypsum stock pile please confirm. | Bidder's understanding is not correct. Retaining wall and peripheral drain around lime stone stock pile and gypsum stock pile along with suitable entry point for dozer entry with ramp need to be provided by the successful bidder. |
| **BARH** | | | | | | | |
| 23. | VI/PART-A | II-A10 | 1 OF 30 | 1.05.00 | Railway siding. | We understand that work of railway siding is not in the scope of bidder. Kindly confirm our understanding is correct. | Bidders understanding is correct. |
| 24. | VI/PART-A | II-A10 | 10 OF 30 | 7.01.00 | FGL generally corresponds to RL 46.20M----------to achieve the FGL as indicated above. | Please furnish the topographical survey drawing and contour drawings of the site. | Bidder to refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
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| 25. | VI/PART-A | II-A10 | 10 OF 30 | 7.01.00 | FGL generally corresponds to RL 46.20M----------to achieve the FGL as indicated above. | We understand that FGD area marked in plot plan is already levelled and graded and now no further leveling and grading is needed. Please confirm. | Site levelling shall be done by Owner as per the levels specified in GLP in tender document.<br>Only site clearance and minor grading is in bidder's scope. |
| 26. | VI/PART-A | II-A10 | 10 OF 30 | 7.03.00 | The foundation system to be adopted for different structures shall be as given below------ | Please furnish the bore log details and drawings showing the locations of various bore logs. | Borelog have already furnished in the tender document. For, location of boreholes, co-ordinates indicated in borelog may be referred. |
| 27. | Plot plan | - | - | 9558/9560-999-POC-F-001/Rev. No.8-D0 | ROAD AND DRAINS | Since FGD facilities are to be incorporated in the existing layout .Kindly furnish the road and drain layout for the present scope of work. | Kindly refer GLP of Barh project furnished with the tender document. |
| **GADARWARA II** | | | | | | | |
| 28. | - | - | - | - | General layout plan | Kindly furnish the FGL to be adopted for the different systems/areas of FGD | FGL is indicated in GLP. |
| **MOUDA II** | | | | | | | |
| 29. | - | - | - | - | General layout plan | Kindly furnish the FGL to be adopted for the different systems/areas of FGD | FGL is indicated in GLP. |
| **NABINAGAR II** | | | | | | | |
| 30. | - | - | - | - | General layout plan | Kindly furnish the FGL to be adopted for the different systems/areas of FGD | FGL is indicated in GLP. |

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| **SOLAPUR** | | | | | | | |
| 31. | - | - | - | - | Geo- technical investigation Report | Kindly furnish geo technical report along with the Recommended SBC and foundation system to be adopted. | The geotechnical investigation report for the vicinity area will be made available for the Bidder's study at the Owner's office. However, for borelog data, bidder may refer Amendment . |
| 32. | - | - | - | - | General layout plan | Kindly furnish the FGL to be adopted for the different systems/areas of FGD | FGL is indicated in GLP. |
| **BRBCL** | | | | | | | |
| 33. | VI/PART-A | II-A11 | 3 OF 29 | 3.00.00 | Railway siding. | We understand that work of railway siding is not in the scope of bidder. Kindly confirm our understanding is correct. | Bidders understanding is correct. |
| 34. | VI/PART-A | II-A10 | 12 OF 29 | 7.02.01 | General Requirement | Please furnish FGL to be considered in FGD area. | FGL is indicated in GLP. |
| 35. | VI/PART-A | II-A10 | 11 OF 29 | 7.03.00 | Geo technical data and foundation system for the respective project are enclosed at Annexure-III .The corresponding bore logs are enclosed at at Annexure-IV. | Bore log details furnished in Annexure-IV are of ash handling area. Kindly furnish the bore log details of FGD area also. | Bidder may refer Clause No.7.00.02, as mentioned in Clause No. 7.00.02, the available borelog data is of vicinity to proposed structure and the same has already been furnished in the tender document for bidder's guidance. Detailed Geotechnical Investigation shall be carried out by contractor. |

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| 36. | Plot plan | | 0270-999-POC-F-001(Rev.No .6) | | ROAD AND DRAINS | Since FGD facilities are to be incorporated in the existing layout .Kindly furnish the road and drain layout for the present scope of work. | Refer General Layout Plan. Road and drain drawing shall be provided after award. |
| **DARLIPALLI** | | | | | | | |
| 37. | VI/PART-A | II-A4 | 1 OF 30 | 1.02.00 | The main plant---railway siding--- | We understand that work of railway siding is not in the scope of bidder. Kindly confirm our understanding is correct. | Confirmed. |
| 38. | VI/PART-A | Annexure-III | 19 OF 30 | | Natural ground level is varying as per enclosed contour/spot level | Please furnish FGL to be considered in FGD area. | FGL is indicated in GLP. |
| 39. | VI/PART-A | II-A10 | 10 OF 30 | 7.00.01 | Geo technical data and foundation system for the respective project are enclosed at Annexure-III .The corresponding bore logs are enclosed at at Annexure-IV. | Kindly furnish annexure- IV as the same is not available with tender document. | Bidder to refer amendment in this regard. |
| 40. | Plot plan | | 9549-999-POC-F-001 | | ROAD AND DRAINS | Since FGD facilities are to be incorporated in the existing layout .Kindly furnish the road and drain layout for the present scope of work. | Refer General Layout Plan. Road and drain drawing shall be provided after award. |

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| 41. | SECTION-VI,PART-B | II-E15 | - | - | - | Street lights shall only be provided for the roads newly constructed by Bidder, under the scope of the subject Tender package.<br><br>Please confirm. | Confirmed. |
| 42. | PART-B-II-ELECT-1 | SUB-SECTION-II-E | 7 | 2.04.00 | All MV & LV circuit breakers shall be provided with Communicable Numerical Relays complying with IEC-61850 as specified in Sub-section II-E-09. These relays shall be integrated with Employer's Switchgear SCADA through Ethemet switches (to be supplied by Employer) mounted on each switchgear. | We understood that the DDCMIS system is the PLC based control system provided by the Bidder and switch gear SCADA system is provided by the Employer.<br><br>As per clause 2.05.00 only 11 KV 3.3 KV & L T Incomers, Ties, Bus couplers, Transformer feeders shall be controlled from Switchgear SCADA and Motor feeders are controlled only from DDCMIS, Please clarify | This clause is deleted.<br><br>Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI) |
| 43. | PART-B-II-ELECT-1 | SUB-SECTION-II- | 7 | 2.04.00 | The circuit breaker will normally be controlled from re- | Please clarify how simultaneous control from two different control system | This clause is deleted. |

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| | | E | | | mote control panels (DDCMIS) through closing and shunt trip coils. The control of the breakers shall also be possible from the Employer's Switchgear SCADA system. | i.e. DDCMIS and Switch gear SCADA will be done through communication IEC-61850. We consider communication with Switch gear SCADA and hardware (DI/DO) interface with PLC. | **Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI)** |
| 44. | PART-B-II-ELECT-1 | SUB-SECTION-II-E | 7 | 2.05.00 | Control Philosophy<br>The Control Philosophy shall be as follows:<br>(a) All the 11 KV/ 3.3 KV & L T Incomers, Ties , Bus couplers, Transformer feeders shall be controlled from Switchgear SCADA and also from DDCMIS.<br>(b) The motor feeders shall be controlled from the DDCMIS only.. | We understood that only 11 KV 3.3 KV & L T Incomers, Ties , Bus couplers, Transformer feeders shall be controlled from Switchgear SCADA and Motor feeders are controlled only from DDCMIS | **Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI)**<br><br>Control Philosophy<br>The Control Philosophy shall be as follows:<br>a) All switchgears and MCCs shall be controlled from PLC/DCS. |
| 45. | PART-B-II-ELECT-III | SUB-SECTION-II-E | 19 | 3.00.00 | Control supply voltage<br>- Trip and closing coils - 240V DC<br>- Spring charging motor - 240V DC | This shall be decided by the Panel manufacturer, can be 220V DC, 110V DC etc. also. | Technical Specifications to be complied with. |

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| 46. | PART-B-II-ELECT-III | SUB-SECTION-II-E | 24 | 4.2.00 | Outgoing breakers shall be suitable for switching transformers and motors at any load. They shall be capable of being used for frequent direct-an-line starting of squirrel cage induction motors of following ratings:<br><br>3.3KV - Above 160 kW up to 1500 kW (The contractor may adopt 415V/3.3KV for drives rated in the range of 160-210 kW)<br><br>6.6 kV - Above 200 kW<br><br>11kV - Above 1500 kW | As per PART-B-II-ELECT-1, Clause-1.06.00, page 4/46, it is mentioned as<br><br>The voltage level for motors shall be as follows:<br>a) Upto 0.2 KW - Single phase 240V AC / 3 phase 415V AC<br>b) Above 0.2 KW and uplo 200 KW - 3 phase, 415V AC<br>c) Above 200 KW and upto 1500 KW - 3 phase, 3.3 kV AC<br>d) Above 1500 KW - 11 kV<br>The bidder may adopt 415V/3.3 KV for the drives rated in the range of 160-210 KW.<br>Both are contredictory.<br>We consider as per the PART-B-II-ELECT-1, Clause-1.06.00, page 4/46 | Technical specification is clear.<br>Either 6.6 kV Or (3.3 KV and 11 kV) exists in any particular project.<br><br>All these three voltage level 3.3kV, 6.6 kV and 11 kV do not exist in any single project simultaneously.<br><br>So there is no contradiction. |
| 47. | PART-B-II-ELECT-III | SUB-SECTION-II-E | 26 | 4.5.1 | The circuit breaker contactor will normally be controlled from remote control panels (DDCMIS) as well as from Switchgear SCADA System (via Numerical Relays) through closing and shunt trip coils. | We understood that the DDCMIS system is the PLC based control system provided by the Bidder and switch gear SCADA system is provided by the Employer.<br><br>Please clarify how simultaneous control from two different control system i.e. DDCMIS and Switch gear SCADA | Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI) |

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| | | | | | | will be done through communication IEC-61850.We consider communication with Switch gear SCADA and hardware (DI/DO) interface with PLC. | |
| 48. | PART-B-II-ELECT-III | SUB-SECTION-II-E | 59 | 3.01.02 | DC SYSTEM<br>1) System Voltage 240 V DC 2-Wire, Unearthed | Shall be decided during detailed engineering as per the panel manufacturer standards, Can be 220V DC also. | Technical Specifications to be complied with. |
| 49. | PART-B-II-ELECT-III | SUB-SECTION-II-E | 59 | 3.01.03 | CONTROL SUPPLY VOLTAGE<br>1) Trip & closing coil of circuit breaker - 240 V DC/120 V DC<br>2) Spring charging motor - 240 V DC/120 V DC | Shall be decided during detailed engineering as per the panel manufacturer standards. Control supply can be 230V AC also. | Technical Specifications to be complied with. |
| 50. | PART-B-II-ELECT-III | SUB-SECTION-II-E | 66 | 4.20.00 | As indicated in schematic drawings of DDCMIS controlled modules, contractor shall supply & mount toNo (2) coupling relays in the corresponding modules. | A per 18.02.00, page 76/224, Control of circuit breakers shall be carried out from DDCMIS through hardwired control commands in the form of 24V DC signal. Preferably, binary input of all relays shall be configurable to accept 24V DC signals directly from DDCMIS and no separate coupling relays shall be provided.<br><br>Please clarify | Please refer Amendment to Technical Specifications(Section VI). |
| 51. | PART-B-II- | SUB- | 76 | 18.03.00 | Each numerical relay shall be | We understood that only the Ethernet | This clause is deleted. |

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| | ELECT-III | SECTION-II-E | | | connected to the Ethernet switch (in Employers's scope) provided in the Switchgear through Cat5e Ethemet 'FO cable. Ethernet Switches shall be connected through Fibre Optic cable to form a ring network. | cable from each relay to the Ethernet switch (employer scope) mounted inside the panel is in Bidder's scope. Connection of Ethernet switches through OFC ring to employer switch gear SCADA is under Employer scope. | Please refer Amendment to Technical Specifications(Section VI) |

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| 52. | VI/A<br>VI/B | III-A.5<br>I-M6 | 6 OF 6<br>2 of 73 | 3.07.00<br>3.01.00 | Unloading of Limestone and loading of Gypsum | We understand any type of Front end loader/ Payloader/ Dozer/ Truck/ Railway wagons/ any type of vehicle are not in bidder's scope.<br><br>Please confirm | Confirmed. |

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| 53. | VI/A | III-A.5 | 5 OF 6 | 2.01.28 | Minimum one (1) no. Weighing Bridge for Road trucks / Tipplers shall be provided in Limestone unloading area and in Gypsum Loading area. | 1) Please clarify whether common weigh bridge is required for both Lime Handling & Gypsum Handling area or separate weigh bridge is required for each area.<br>2) Kindly Provide weigh bridge capacity. | (1) Separate one number weigh bridge shall be provided for Lime Stone Handling area and for Gypsum Handling area.<br>(2) Weigh bridge capacity shall be 100 MT. |
| 54. | VI/B<br><br><br><br>VI/A | I-M6<br><br><br><br>V | 18 of 73<br>20 of 73<br><br><br>25 of 26 | 4.13.1<br>4.13.19<br><br><br>10.15.00 | The dust control system to be furnished under this specification is required for control of fugitive dust emissions from dust generation points such as junction towers, truck un-loading points, crushers etc.<br><br>For dust control in limestone storage shed … trolley mounted dust collection hopper with bag filters shall be provided.<br><br>Location: Belt feeder after crusher & Vibrating Screening Feeder at crusher house. | Please provide location and type for DE system for each area. | The areas to be covered by dust extraction system shall be truck unloading points, junction towers (limestone/gypsum discharge & receipt points), limestone/gypsum crusher house (including belt feeder & vibrating feeder) and lime stone/gypsum storage shed.<br><br>Dust Extraction System shall comprise of bag filters, fans, bag filter & collection hoppers. The whole area shall be segregated in different groups and dedicated DE system for each group shall be provided. Necessary amendment in this regard shall be issued. |

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| 55. | | | | | Project List | - FGD system to be considered only for Stage -1 for Barh project (3X660MW) & Stage –II excluded from scope<br>- Gadarwara Stg-1 (2x800MW) considered & stg-2 excluded<br>- Lara Stg-1 (2x800MW) considered & stg-2+3 excluded<br>- Nabingar JV Stg-1 (3X66MW) considered & stg-2 excluded<br><br>Kindly confirm. | Bidders understanding is correct. |
| 56. | VI/A | III-A.5 | 2 OF 6 | 2.01.01 | Lime stone received through Road shall be unloaded by Two (2) numbers Truck Tipplers each of minimum 20T capacity to discharge Limestone on to Box Feeders | Whether Truck Tippler is in scope of bidder or not. | Truck tipplers of gross weight 60 MT capacity are in bidder's scope. Necessary amendment in this regard shall be issued. |

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| 57. | VI/A | III-A.5 | 2 OF 6 | 2.01.01 | Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper | 1) Please inform project wise, which wagon tippler or Track hopper or any one of all wagon tippler and track hopper will be used for unloading limestone.<br><br>2) We request customer to finalize "tapping point" from existing conveyor/JT/CRH for further engineering.<br><br>3) We request customer to provide plan/ elevation drawing of said "tapping point" or GA drawing of that conveyor/JT to ascertain modification work involvement and further engineering. | (1) Either of Wagon Tippler or Track Hopper shall be used for unloading of limestone received using Indian Railways rakes as per availability.<br><br>(2) Feed for uncrushed limestone shall be taken before existing crusher house of Coal Handling plant as specified in the reference clause. Final Tapping point shall be decided based on the layout of FGD system and existing facilities.<br><br>(3) Please refer reply against S.No. 57(2)above. |

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| 58. | VI/A | III-A.5 | 2 OF 6 | 2.01.04 | One (1) number Lime stone crusher house (CH) complete. | 1) Whether existing crusher House can be permitted for crushing.<br><br>2) Tapping/diversion can be taken after crushing in any junction tower afterwards if layout permits.<br><br>3) For limestone coming through roads, separate CH of suitable size may be provided at suitable location. | (1) Technical Specifications is clear in this regard. A separate Limestone Crusher House dedicated for the FGD plant shall be provided by bidder.<br>(2) Technical Specifications is clear in this regard. In case of railway rake unloading tapping for limestone shall be taken before existing crusher house of Coal Handling Plant. All modifications in the existing CHP for the same shall be in bidder's scope.<br>(3) Common limestone crusher house for both cases – unloading with road trucks and unloading with indian railways rakes, shall be provided. |
| 59. | VI/A | III-A.5 | 6 OF 6 | 3.05.00 | Common pump house for Limestone handling plant gypsum handling plant is also acceptable. | Query-1: Whether one common pump house is acceptable for complete FGD<br>Query-2: Whether tapping from existing CHP water system is allowable nearer to Limestone handling plant gypsum handling plant for service, potable and dust suppression system. | Reply to Query-1: Acceptable.<br><br>Reply to Query-2: Tapping from existing CHP water system is not acceptable. |

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| 60. | VI/A | III-A.5 | 4 OF 6 | 2.01.19 | One (1) number of passenger cum goods elevator with drives, all electrical, mechanical, civil, structural & associated foundation works, accessories and electrical to serve various floors of lime stone crusher house | Type of elevator is not mentioned in the tender specification. Vendor shall consider as per his choice. Please clarify. | One (1) number conventional enclosure type passenger cum goods elevator having capacity of 16 persons (1088 kg) complying to IS:14665 (latest edition) with drives, all electrical, mechanical, civil, structural & associated foundation works, accessories and electrical to serve various floors of lime stone crusher house. Staircase access for machine room shall also be provided by the bidder. |
| 61. | VI/A | VI | 20 OF 24 | 5.00.00 | Auxiliary Power Consumption | 1) Power consumption for limestone & gypsum handling system is not included in list. Hence not considered.<br>2) If the power consumption is to be considered, then request customer to kindly furnish the list of equipment's to be considered for arriving at auxiliary power consumption along with duty factor. | 1) &2) Bidder to refer amendment in this regard. |

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| 62. | VI/B | I-M6 | 10 of 73 | 4.6.2 | 1 mtr x 1 mtr size dust/debris MS chutes | The size given in the tender specifications seems to be on a higher side.<br><br>We propose 500 dia MS pipe of thickness 6mm(min). Kindly confirm. | Bidder shall comply the technical specifications. |
| 63. | VI/A | III-A.5 | 3 OF 6 | 2.01.04 | external and internal staircases... for CRH | One staircase is sufficient since elevator is envisaged in limestone crusher house.<br><br>Kindly confirm. | Bidder shall comply the technical specifications. |
| 64. | Plot Plan (Tender drawings) | | | | GLP (Limestone handling system/Gypsum handling system) | Bidder requests customer to furnish the location of lime handling & gypsum handling facilities in the plot plan. | Technical Specifications is clear. Bidder is to propose the location of lime stone handling & gypsum handling facilities as per GLP and meeting the requirement of FGD plan layout. |
| 65. | Plot Plan (Tender drawings) | | | | GLP (Limestone handling system/Gypsum handling system) | The space shown in plot plan for limestone unloading & feeding to storage silo is not sufficient.<br><br>Kindly review & confirm. | Bidder shall comply with the requirement of Technical Specification. However, the requirement for space will be deliberated with the Bidder during post techno commercial bid discussion. |

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| 66. | (Tender drawings) | | | | Limestone handling system/Gypsum handling system | Please furnish flow diagrams for lime stone handling and gypsum handling plants as same are not available along with tender specifications. | Technical Specifications is clear'. Bidder is to propose the scheme in line with the requirements of technical specifications. |
| 67. | (Tender drawings) | | | | Gypsum/ Byproduct : Gypsum Storage Yard for Wet FGD | Please indicate the location of gypsum storage in the plot plan. | Refer our reply above. |
| 68. | | | | | Gypsum/ Byproduct : Gypsum Storage Yard for Wet FGD | Kindly furnish quantity of gypsum produced per hr. to decide the capacity of gypsum handling conveyor.<br><br>Also clarify any design margin is to be considered over rated capacity. | Bidders query is not clear as gypsum will be produced in FGD Absorber which is in the scope of Bidder. |
| 69. | | | | | Limestone handling system/Gypsum handling system | Kindly Furnish limestone consumption rate for arriving stockpile capacity. | Bidders query is not clear as limestone will be required in FGD Absorber which is in the scope of Bidder. |
| 70. | | | | | Gypsum/ Byproduct : Gypsum Storage Yard for Wet FGD | 07 days storage is required for both limestone & gypsum. But no sufficient storage space available at given plot plan.<br><br>Kindly review & confirm | Bidder to refer amended GLP for the same. |

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| 71. | | | | | Gypsum/ Byproduct : Gypsum Storage Yard for Wet FGD | Kindly furnish angle of repose for limestone & gypsum. | Angle of repose shall be considered as 38 deg for limestone and 35 deg for gypsum. |
| 72. | SECTION-VI, PART-B, | SUB-SEC-TION-I-M6, LIME-STONE HAN-DLING PLANT | 3.1.0 | 128 OF 274 | A mechanised system shall be.....before limestone crusher. | Bidder is considering over ground truck tippler and dedicated lime-stone handling conveyor of capaci-ty 150 TPH till limestone crusher.<br><br>Please confirm. | Confirmed. However for unloading through existing WT/Track Hopper, the minimum stream capacity shall be 1200 MTPH. |
| 73. | SECTION-VI, PART-B, | SUB-SEC-TION-I-M6, LIME-STONE HAN-DLING PLANT | 3.2.0 | 128 OF 274 | "As received" limestone shall be .....up to limestone bunkers. | Bidder understands that the uncrushed limestone received from wagon tippler will be conveyed through existing coal conveyors and will be re-routed through new limestone conveyors till limestone crushers. After crushing, crushed limestone shall be conveyed to limestone storage shed.<br><br>Please confirm. | Confirmed. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 74. | SECTION-VI, PART-B, | SUB-SEC-TION-I-M6, LIME-STONE HAN-DLING PLANT | 3.3.0<br><br>&<br><br>4.12.3 | 129 OF 274<br><br>144 of 274 | Crushing: "In limestone crusher house, limestone from each con-veyor shall pass through 2 nos crushers 7 screens…….. ……from either stream.<br><br>Primary samplers …… ……rated conveyor capacity. | Bidder is considering 1X100% crusher in crusher house for each incoming stream.<br>Please confirm.<br><br>Based on our experience, screens are not required below the crush-ers. Crusher is designed to have final product size (-) 20mm.<br><br>Hence we are not considering any screen equipment below the crushers.<br><br>Please check and confirm. | Bidder shall comply the technical specifications. |
| 75. | SECTION-VI, PART-B, | SUB-SEC-TION-I-M6, LIME-STONE HAN-DLING PLANT | 3.4.0 | 129 OF 274 | Crushed limestone shall be stored in cov-ered…….. ……junction towers and ploughs/fixed trippers. | Bidder understand that the crushed limestone (-20mm) shall be stored in a covered storage yard.<br><br>However, use of travelling tripper and paddle feeders not under-stood.<br><br>Please elaborate and review the requirement. | Travelling tripper has been envis-aged to distribute crushed lime-stone along the length of limestone storage shed.<br><br>Paddle feeders are provided to re-claim the stored crushed limestone and feed it to the outgoing lime-stone conveyors to store limestone FGD usage point. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 76. | SECTION-VI, PART-B, | SUB-SEC-TION-I-M6, LIME-STONE HAN-DLING PLANT | | | | Bidder request customer to specify the maximum lime stone and gyp-sum pile height to be considered to arrive the size of storage area and shed to make all the bidders at par. | Maximum pile height shall be de-cided considering the availability of space during detailed engineering. |

**CIVIL-MOUDA**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 77. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Lay-out plan |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 78. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site levelling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Lay-out plan |
| 79. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |
| 80. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 81. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Type of cladding system if not specified in the technical Specification shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints ( if any). |
| 82. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Extent and type of paving in FGD block shall be in accordance with Technical specification. However, any functional requirement of paving for FGD facilities not specifically mentioned in technical specification is also in the scope of bidder. |
| 83. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 84. | VI/A | II-A5 | 22 OF 40 | Annexure-III, e) | The minimum pile length for each group of piles shall be determined based on the nearest bore log. A minimum embedment of 5.0 m and 6.0 m into strata with SPT 'N' greater than 50 for 600 mm dia pile and 760 mm dia pile respectively before termination and at pile termination minimum SPT 'N' shall be 60, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby bore log data. | The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm. | Bidder shall comply the provisions of technical specification. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 85. | VI/A | II-A5 | 14 OF 40 | 7.02.03 xv | High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. | High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm. | Bidder to refer amendment in this regard. |
| 86. | General | - | - | - | - | Lab test results of geotechnical investigation may please be furnished. | Bidder to refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**CIVIL-SOLAPUR**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 87. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 88. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 89. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately. |
| 90. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately |
| 91. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel superstructure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel superstructure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Refer Sl. No.81 |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 92. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Refer Sl. No.82 |
| 93. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | |
| 94. | VI/A | II-A6 | 9 of 31 | 7.00.01 | Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV. | Annexure-IV is not available in the specification. Please provide the same. | Bidder to refer amendment in this regard. |

**CIVIL-MEJA**

| SL. | ENQUIRY SPECIFICATION | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| NO | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
|---|---|---|---|---|---|---|---|
| 95. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 96. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 97. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |
| 98. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 99. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Refer Sl. No. 81 |
| 100. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Refer Sl.No.82 |
| 101. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | Refer Sl.No.82 |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**CIVIL-BARH**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 102. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 103. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 104. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately. |
| 105. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately. |
| 106. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel superstructure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel superstructure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Refer Sl.No.81 |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 107. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Refer Sl.No.82 |
| 108. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | |
| 109. | VI/A | II-A10 | 10 OF 30 | 7.02.00 | For excavation 6 metres below FGL, sheet piling shall be provided. | Any suitable slope protection works can be provided. Please confirm | Excavation may be carried out by using either sheet piling/ diaphragm wall/ secant piling/ contiguous piling or their combination. Bidder to refer amendment in this regard. |
| 110. | General | - | - | - | - | Topographical survey details is not available in the specification. Please furnish the same. | Bidder to refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**CIVIL TANDA**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 111. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 112. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 113. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 114. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |
| 115. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Refer Sl.No.81 |
| 116. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth | Refer Sl.No.82 |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 117. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | |
| 118. | VI/A | II-A7 | 22 OF 33 | Annexure-III, e) | The minimum pile length for each group of piles shall be determined based on the nearest bore log. A minimum embedment of 4.0m into the very dense sand strata with SPT 'N' value greater than 50 as observed in such bore log shall be ensured, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby bore log data. | The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm. | Bidder shall comply the provisions of technical specification. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 119. | VI/A | II-A7 | 14 OF 33 | 7.02.03 xv | High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. | High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm. | Bidder may conduct either static routine load test or high strain dynamic load test. Bidder to refer amendment in this regard. |
| 120. | General | - | - | - | - | Lab test results of geotechnical investigation may please be furnished. | Bidder to refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**CIVIL NPGCPL NABINAGAR**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 121. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 122. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 123. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 124. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |
| 125. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Refer Sl.No.81 |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 126. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Refer Sl.No.82 |
| 127. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | |
| 128. | VI/A | II-A8 | 9 OF 31 | ANNEX-URE-B | a) The basic wind speed "Vb" at ten | Kindly specify the basic wind speed. | The basic wind speed "Vb" at 10m height above the mean ground level for "NABINAGAR-I 3X660 MW" project shall be 47 metres/second. Also refer Amendment issued separately in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 129. | VI/A | II-A8 | 21 OF 31 | Annexure-III, e) | The minimum pile length for each group of piles shall be determined based on the nearest bore log. A minimum embedment of 4.0m into the very dense sand strata with SPT 'N' value greater than 40 as observed in such bore log shall be ensured, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby bore log data. | The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm. | Bidder shall comply the provisions of technical specification. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 130. | VI/A | II-A8 | 13 OF 31 | 7.02.03 xv | High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. | High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm. | Bidder may conduct either static routine load test or high strain dynamic load test.<br>Bidder to refer amendment in this regard. |
| 131. | General | - | - | - | - | Lab test results of geotechnical investigation may please be furnished. | Bidder to refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 132. | General | - | - | - | - | Topographical survey details is not available in the specification. Please furnish the same. | Bidder to refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**CIVIL BRBCL NABINAGAR**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 133. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 134. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 135. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 136. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | |
| 137. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thick-ness of 0.8mm as permanent shutter-ing... | In case Bidder opts for steel su-per-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Refer Sl.No.81 |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 138. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Refer Sl.No.82 |
| 139. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | |
| 140. | VI/A | II-A11 | 22 OF 29 | Annexure-III, e) | The minimum pile length for each group of piles shall be determined based on the nearest bore log. Pile shall be socketed into yellowish weathered sand stone. A socketing length of four (4) times the diameter of the pile into rock with rock core recovery ≥ 20% shall be ensured for 600 mm & 760 mm dia piles. | The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm. | Bidder shall comply the provisions of technical specification. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 141. | VI/A | II-A11 | 15 OF 29 | 7.02.03 xv | High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. | High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm. | Bidder may conduct either static routine load test or high strain dynamic load test.<br>Bidder to refer amendment in this regard. |
| 142. | General | - | - | - | - | Lab test results of geotechnical investigation may please be furnished. | Bidder to refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**CIVIL BRBCL (MOUDA, SOLAPUR,MEJA,BARH,TANDA, NPGCPL NABINAGAR & BRBCL NABINAGAR)**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| 143. | SEC / PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 144. | VI / A | V | 8 OF 26 | 5.01.00 | A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor... | The location of new Wet Chimney shall be near to Existing Chimney in the space provided clearing foundation interface. The design of Wet Chimney shall be done considering interface factor of existing chimney as determined by wind tunnel study. However, no design check or validation shall be done for existing chimney/structures/buildings. Kindly confirm. | It is confirmed that no design check or validation shall be done by the bidder for existing chimney(s). |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**C&I (MOUDA & BARH)**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 145. | Section VI/Part -A | Sub-Section VII | Page 13 of 61<br><br>Page 19 of 61 | Clause 1.19.00<br><br>Clause 1.21.00 | Mandatory spares-<br>AC & Ventilation system (Control & Instrumentation) | C&I Mandatory spares for AC & Ventilation are covered in both clauses and are repeated also. Only Clause 1.19.00 (3) will be considered for C&I spares. Please confirm. | Refer amendment in this regard. The referred clause 1.19.00 stands deleted. Bidder to refer relevant amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 146. | Section VI/Part -A | Sub-Section VII | Page 45 of 61 | Clause 1.25.00 | Mandatory spares- (Control & Instrumentation) | C&I mandatory spares for AC & ventilation system and Compressed air system shall be provided as per clause 1.19.00 and 1.23.00 respectively. Mandatory Spares mentioned under Clause 1.25.00 shall not be applicable for above mentioned packages. Please confirm. | Refer amendment in this regard. |

**C&I (TANDA, NPGCPL NABINAGAR & BRBCL NABINAGAR)**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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|---|---|---|---|---|---|---|---|
| 147. | Section VI/Part -A | Sub-Section VII | Page 13 of 61<br><br>Page 19 of 61 | Clause 1.19.00<br><br>Clause 1.21.00 | Mandatory spares-<br>AC & Ventilation system (Control & Instrumentation) | C&I Mandatory spares for AC & Ventilation are covered in both clauses and are repeated also. Only Clause 1.19.00 (3) will be considered for C&I spares. Please confirm. | Refer amendment in this regard. The referred clause 1.19.00 stands deleted. Bidder to refer relevant amendment in this regard. |
| 148. | Section VI/Part -A | Sub-Section VII | Page 45 of 61 | Clause 1.25.00 | Mandatory spares-<br>(Control & Instrumentation) | C&I mandatory spares for AC & ventilation system and Compressed air system shall be provided as per clause 1.19.00 and 1.23.00 respectively. Mandatory Spares mentioned under Clause 1.25.00 shall not be applicable for above mentioned packages. Please confirm. | Refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 149. | Section VI/Part-A | Sub-Section VII | Page 13 of 61<br><br>Page 19 of 61 | Clause 1.19.00<br><br>Clause 1.21.00 | Mandatory spares-<br>AC & Ventilation system (Control & Instrumentation) | C&I Mandatory spares for AC & Ventilation are covered in both clauses and are repeated also. Only Clause 1.19.00 (3) will be considered for C&I spares. Please confirm. | Refer amendment in this regard. The referred clause 1.19.00 stands deleted. Bidder to refer relevant amendment in this regard. |
| 150. | Section VI/Part-A | Sub-Section VII | Page 45 of 61 | Clause 1.25.00 | Mandatory spares-<br>(Control & Instrumentation) | C&I mandatory spares for AC & ventilation system and Compressed air system shall be provided as per clause 1.19.00 and 1.23.00 respectively. Mandatory Spares mentioned under Clause 1.25.00 shall not be applicable for above mentioned packages. Please confirm. | Refer amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**MECHANICAL PIPING & LAYOUT**
**(MOUDA, SOLAPUR,MEJA,BARH,TANDA, NPGCPL NABINAGAR & BRBCL NABINAGAR)**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 151. | Section –VI, Part-A | Sub Sec-tion- III-A1 | Page 7 of 9 | 14.00.00 | The contractor scope shall also include the provision of FGD tres-tle for routing of air & water lines, slurry lines, steam line, waste water, etc. required for the complete process operations. | It is understood that pipe racks need to be constructed in new area for FGD requirement. However, existing pipe racks shall be used for routing pipes related to FGD system wherever need to do so arises.<br>Kindly confirm. | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section – VI, Part-A, shall be complied with w.r.t trestles. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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|---|---|---|---|---|---|---|---|
| 152. | Section –VI, Part-A | Sub Sec-tion-III-A1 | Page 7 of 9 | 11.00.00 | Buildings | Please clarify whether various Equip-ment Cooling Water Auxiliaries of FGD system are to be kept in Pump house or shed. | Bidder shall provide Pump house. |

**ELECTRICAL (MOUDA, SOLAPUR & MEJA)**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 153. | PART A/ SECTION- VI & Drg No. 0011-109-POE-J-001 | IIIB | 1 OF 6 | 1.02.00 | HT/LT SWITCHGEAR: Feeding arrangement | 1. It is clarified that the modification work in customer's 11kV SWGR shall be in customer's scope and the control of 11kV breakers from customer's DDCMIS shall be in customer's scope. Any change of logics in customer's existing control panel or DCS shall be arranged by customer. Please confirm.<br><br>2.Please also confirm that the feeding arrangement shown in the SLD is indicative and actual arrangement of boards/ number of boards can be changed/ altered during the detailed engineering by the bidder based on the actual loads. | Bidder to refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI) in this regard and Annexure. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 76. | Drg No. 0011-109-POE-J-001 | -- | -- | -- | 2 nos. feeders to Existing CHP/AHP aux. transformer. | 1. Cables & Cabling for these two 11kV HT feeders shall be in customer scope & is excluded from bidder's scope of supply & erection.<br><br>2. Customer to provide load (kVA) details for existing CHP/AHP along with any other load/feeder requirement for owner's use (if any). | Same as above. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 154. | PART A/ SECTION- VI | IIIB | 2 OF 6 | 1.08.00. 2) | Cabling: Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 on the employers nearest trestle in the FGD area as shown in Drg no 0011-999-POC-F-001 subject to availability of space and suitability. In case of non-availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection & cable laying. | 1. Drg No. 0011-999-POC-F-001 is not available. Please provide.<br><br>2. Since there is a shortage of space in the Main plant area, separate structure/ trestle is not possible to connect the Main plant to FGD. Where-ever there is no space in customer's trays, it is understood that bidder will utilize customer's trestle to erect cable trays. The number of cables from Main plant 11 KV SWGR to 11 KV FGD SWGR can be finalized only after receipt of CHP / AHP load from customer.<br><br>3. Runway conductor available in customer's trestle (between main plant and FGD) will be utilized for earthing purpose and runway conductor for earthing of cable trays laid on these trestles are excluded from bidder's scope . Only tapping from customer's run way conductor to cable trays supplied by bidder shall be in bidder's scope. | 1. Bidder to refer necessary amendment in this regard.<br><br>2. Bidder shall comply with technical specification requirement clause no: - 1.08.00.2.<br><br>3. Bidder can utilize employers run away conductor wherever available. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 155. | PART B/ SECTION- VI & Drg No. 0011-109-POE-J-001 | II-E11 | 12 OF 19 | 9.02.01 | Rating of DG: The continuous rating of the alternator under the specified ambient condition shall be at least equal to the net electrical output specified for the DG set plus the power requirements of all electrical auxiliaries connected to the alternator terminal including excitation (if it is taken from alternator terminals) & as per system requirement | Please confirm that bidder will have the flexibility to choose the rating based on the actual load sizing during detail engineering. | Bidder shall comply with technical specification. |
| 156. | PART B/ SECTION- VI | II-E15 | 05 OF 16 | 4.00.00.3 | Lighting Masts | Number of Lighting Masts is not specified in the specification. Please confirm the minimum number. | The same shall be decided during detailed engg. |
| 157. | PART B/ SECTION- VI & OOOD-209-POE·A-002 | II-E16 | 01 OF 13 | 1.00.00 & 9.00.00 | DC health monitoring system shall be offered integral with each battery set for Main Plant & Switchyard batteries. | DC health monitoring system is excluded from bidder's scope of supply for 220V DC Battery for FGD area. Please confirm. | Confirmed. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUB-SEC. | PAGE NO. | CLAUSE NO. | | | |
| 158. | PART C/ SECTION- VI | | 75 OF 83 | | PA SYSTEM | There is no specification for PA system in detailed technical specification Part A & B-Electrical. However, in Part C the reference standards only are mentioned. Please confirm whether PA system is to be considered a part of FGD or not. If to be considered, please provide the detailed specification for the same. | It is clarified that Public Address (PA) system is not in the scope of the bidder. |
| 159. | PART B/ SECTION- VI | II-E12 | 08 OF 31 | 2.00.00.f | LT Transformer : Outdoor transformers shall have energy efficiency level 3 as per IS 1180. | Please confirm whether LT transformers shall be designed as per IS 1180 or BEE guideline. | Bidder shall comply with specification clause no. 2.00.00.f of Part B/ Section-VI sub section II – E12 and relevant directives as per GOI. |

**HOISTS**
**(MOUDA, SOLAPUR,MEJA,BARH,TANDA, NPGCPL NABINAGAR & BRBCL NABINAGAR)**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 160. | SEC VI, PART-B | I-M1 | 35 OF 51 | 14.09.00 | Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more.<br>Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc. | Referred clauses are contradictory w.r.t selection of electric or manual hoist. We shall follow clause 10.09.00 of sub-section V/Section VI Part A for selection of electric or manual hoist.<br><br>Kindly confirm. | Bidder shall comply with the specification requirements. |
| 161. | SEC VI, PART-B | I-M6 | 6 OF 73 | 4.3.2 | For the hoists with more than 2.0 tonne lifting capacity or more than 10.0 m lift with the exception of hoists for GTU & bend pulleys motor operated hoist blocks for both long travel & lift shall be provided. | | The referred clauses of technical specifications are very clear and pertains to the requirements of Limestone Handling System & Gypsum Handling System and shall be read independent of the hoist requirement brought out in Sub-section I-M1, Section VI, Part-B. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 162. | Section-VI, PART-A | Sub-Section-V | 23 OF 26 | 10.09.00 | Hoists<br>Drive<br>(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings — Motor driven for both travel & lift.<br>(ii) Other hoists including the hoists for handling take-up pulley and take-up weight — Manual for both travel & lift. | | The referred clauses of technical specifications are very clear and pertains to the requirements of Lime-stone Handling System & Gypsum Handling System and shall be read inde-pendent of the hoist re-quirement brought out in Sub-section I-M1, Section VI, Part-B. |
| 163. | Section-VI, PART-B | I-M1 | 35 OF 51 | 14.09.00 | Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. | Considering the layout & space constraints, it may not be feasible to provide all electric hoists with maintenance / repair plat-forms with handrails. Hence maintenance plat-form shall be provided de-pending upon feasibility. | Specification requirement is clear in this regard. Bid-der shall comply with the specification requirements. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 164. | Section-VI, PART-A | Sub-Section-VII | 18 OF 61 | A-10 | MANDATORY SPARES:<br><br>Spares for Electrically operated hoist for FGD WWT system for ZLD (for each type & size) | 1) Mandatory spares of Electric hoists have been mentioned under these two referred clauses/ areas only. Kindly clarify whether Mandatory spares are to be considered for Electric Hoists in area, other than specified in referred clause. In case the same has to be considered, then kindly inform about applicable list of mandatory spares to be followed.<br><br>2) Further, no spares are mentioned for chain pulley blocks. We understand that no spares shall be provided for chain pulley blocks. Please confirm. | Bidder shall comply with the specification requirements given under the clauses referring to the equipment under the sub section VII. |
| 165. | Section-VI, PART-A | Sub-Section-VII | 39 OF 61 | K | Mandatory Spares of Limestone & Gypsum Handling: ELECTRIC HOISTS | | 2) Confirmed. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

**COMPRESSED AIR SYSTEM**
**(MOUDA, SOLAPUR,MEJA,BARH,TANDA, NPGCPL NABINAGAR & BRBCL NABINAGAR)**

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 166. | SECTION-VI / PART-B | I-M3 COM-PRESSED AIR SYS-TEM | 1 OF 7 | 1.01.00 | The compressed air system shall consist of ..... and **Unit Instrument air receivers (One for each Unit).** | Bidder understands that the scope of air receivers is as per technical specification Clause no. 3.00.00, Scope of supply & services, SEC-TION-VI / PART-A, Sub section-III-A2, page 3 of 4.<br>Separate Unit Instrument air re-ceivers are not applicable.<br>NTPC to confirm. | Bidder's understanding is correct. Bidder to refer relevant amend-ment for more clarity. |
| 167. | SECTION-VI / PART-B | I-M3 COM-PRESSED AIR SYS-TEM | 1 OF 7 | 2.02.00 | Design and Construction – **For Compressor** | MOC of all components within compressor skid shall be as per OEM standard. The MOC and de-sign of all components outside the skid shall be as per technical speci- | Bidder shall comply with specifica-tion requirement. However, any superior material may be accepted as per manufacturer proven design practice. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 168. | SECTION-VI / PART-B | I-M3 COM-PRESSED AIR SYS-TEM | 2 OF 7 | 4.00.00 | Intercooler, Aftercooler & Oil coolers (For Screw) | fication/NIT. This is being followed in all the projects executed by bid-der for NTPC and other customers. Pl. accept. | |
| 169. | SECTION-VI / PART-B | I-M3 COM-PRESSED AIR SYS-TEM | 2 OF 7 | 3.01.00 | Air Compressor (Screw / **Centrif-ugal**)..... | Bidder have considered oil free Screw type compressor only in view of small rating. Centrifugal compressor for such small capacity compressors are not available. NTPC to note. | Noted. Bidder to refer relevant amendment . |
| 170. | SECTION-VI / PART-B | I-M3 COM-PRESSED AIR SYS-TEM | 2 OF 7 | 3.04.00 | Compressor frame shall have **min. 10% extra capacity**. Com-pressor shall have **25% min. turndown capacity**. Compressor shall be provided with **IGV at the suction** flange. | Bidder have considered oil free Screw type compressor only. Hence this clause related to cen-trifugal type compressor shall not be applicable on Oil free screw compressor. Pl. confirm. | Bidder to refer amendment. |
| 171. | SECTION-VI | I-M9 MDL | 21 OF 24 | 9.02.00 | SL. NO. 570 MQP OF LT MOTOR FOR AIR COMPRESSOR (ABB MAKE) | Pl. note that make of motor shall be as per NTPC approved makes for LT motor. Pl. accept. | Bidder's understanding is correct. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 172. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(a) | Two numbers (1 W + 1S) oil free, rotary screw type air compressors for Instrument air & service air application for…… | 1.) Bidder understands that two number compressors shall be provided for the Station and not for individual unit.<br>Pl. confirm.<br>2.) Also the common compressor is to be provided for Instrument air & Service application. NTPC to confirm whether the common piping network to be provided for Instrument air and Service air application for plant use or a separate network of Instrument air & Service air to be provided.<br>Pl. clarify, as bidder have considered common piping network for IA & SA application. | Bidder's understanding is correct.<br>A separate network for IA and SA shall be provided.<br>Bidder to refer relevant Amendment. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 173. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(a) | The min. capacity of each air compressor shall be 15 Nm3/min..... | Bidder request NTPC to accept the capacity of compressor as per design criteria given under cl. no. 9.01.00, Salient design data, SECTION-VI / PART-A, Sub section-V, page 20 of 26 OR compressor capacity of 15 Nm3/min whichever is lower. Pl. confirm. | Bidder shall comply with specification requirement. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 174. | SECTION-VI / PART-A | V SALIENT DESIGN DATA & SIZING | 20 OF 26 | 9.01.00(a) | Air compressor shall be designed to meet the instrument air & service air requirement.....as per given formula | The formula for compressor sizing furnished by NTPC is not considering pneumatic air requirements for multiple nos. of Units for a particular project i.e. formula remain same for 1*660 MW,2*660 MW, 3*660 MW etc.<br><br>As the given formula is applicable for various projects, where in number of Units vary from 2 units to 4 units.<br><br>**Pl. clarify whether the same formula to be used for all projects irrespective of number of units i.e. on station basis.** | Bidder's understanding is correct that Formula was given on **Station** basis. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 175. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(d) | One number air receiver of capacity 2m3 for ZLD…… | Bidder shall provide the air receiver for ZLD specifically where ZLD requirement is applicable for that project.<br>Pl. confirm. | Bidder's understanding is correct. |
| 176. | SECTION-VI / PART-A | IV TERMINAL POINTS & EXCLUSIONS | 3 OF 3 | 1.14.00(B) | Instrument air at one point (if required). | NTPC have asked for standalone compressed air system in order to meet the instrument air requirement for FGD.<br>Pl. clarify whether additional tapping from existing instrument air network shall also be provided for meeting instrument air requirement for FGD. If yes, pl. furnish the coordinates for the terminal point. | Amendment will be issued in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 177. | SECTION-VI / PART-A | VI FUNC-TIONAL GUARAN-TEES & LIQUIDITY DAMAGES | 22 OF 24 | xxiii | Total power consumption at motor input terminal at rated duty of air compressor..... | Bidder request NTPC to specify the duty factor for considering the auxiliary power consump-tion for Compressed air system. As the continuous consumption of compressed air will be much lesser than the rated compres-sor capacity specified by NTPC. In such case, the compressor will go under unload conditions for a considerable time and thus lower power requirements. We request you to specify duty point for air compressors. | Duty point shall be 1.0 . Bidder shall comply with specification require-ment. |
| 178. | SECTION-VI / PART-A | VI FUNC-TIONAL GUARAN-TEES & LIQUIDITY DAMAGES | 19 OF 24 | xv | Compressed air system<br>b.) Following shall be demon-strated at site. | Clause no. b(iii) is missing.<br><br>NTPC to please provide the same. | The clause b(iii) does not exist . |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 179. | SECTION-VI / PART-A | III-A2 AIR CON-DITION-ING, VEN-TILATION SYSTEM & COM-PRESSED AIR SYS-TEM | 3 OF 4 | 3.00.00 | Compressed air system | Clause no. 3.00.00(e) & 3.00.00(f) are missing.<br><br>NTPC to please provide the same. | Clause no. 3.00.00(e) & 3.00.00(f) does not exist. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | **C&I** | | |
| 180. | Section VI/Part-A | Sub-Section VII | Page 13 of 61<br><br>Page 19 of 61 | Clause 1.19.00<br><br>Clause 1.21.00 | Mandatory spares-AC & Ventilation system (Control & Instrumentation) | C&I Mandatory spares for AC & Ventilation are covered in both clauses and are repeated also. Only Clause 1.19.00 (3) will be considered for C&I spares. Please confirm. | Refer amendment in this regard. The referred clause 1.19.00 stands deleted. Bidder to refer relevant amendment in this regard. |
| 181. | Section VI/Part-A | Sub-Section VII | Page 45 of 61 | Clause 1.25.00 | Mandatory spares-(Control & Instrumentation) | C&I mandatory spares for AC & ventilation system and Compressed air system shall be provided as per clause 1.19.00 and 1.23.00 respectively. Mandatory Spares mentioned under Clause 1.25.00 shall not be applicable for above mentioned packages. Please confirm. | Refer amendment in this regard. |
| | | | | | **ELECTRICAL** | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 182. | PART B/ SECTION-VI | II-E1 | 4 OF 7 | 2.05.00 | Control Philosophy | Control of 11kV breakers (from 11kV station switchboards) from customer's DDCMIS shall be in customer's scope. Any change of logics in customer's existing control panel or DCS shall be arranged by the customer. Please confirm. | Please refer Amendment to Technical Specifications(Section VI).<br><br>b) "All switchgears and MCCs shall be controlled from PLC/DCS. |
| 183. | Drg No. 0011-109-POE-J-001/A-E | PART E | | Note No. 10 of Drg No. 0011-109-POE-J-001/A-E | Two number 11kV.....of bidder. | 1. It is clarified that necessary augmentation and modification required in customer's 11kV SWGR for two no. 11 kV motors per unit from existing spare feeder from station swbd shall be done by the customer. Please confirm.<br><br>2. Please also confirm that the feeding arrangement is also indicative and the actual arrangement of boards/ number of boards can be changed/ altered during the detailed engineering by the bidder based on the actual loads. | Please refer Amendment to Technical Specifications(Section VI). |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION RE-QUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 184. | Drg No. 0011-109-POE-J-001/A-E | -- | -- | Note No. 11 | Panel being used.....scope of bidder. | 1. Cables & Cabling (Cable trays, tray supports, termination & jointing kits, clamps etc.) for these two 11kV HT feeders shall be in customer scope & is excluded from bidder's scope of supply & erection. Please Confirm.<br><br>2. Customer is requested to provide load (kVA) details for existing CHP/AHP along with any other load/feeder requirement for owner's use (if any). | Please refer Amendment to Technical Specifications(Section VI). |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 185. | PART A/ SECTION-VI | IIIB | 2 OF 6 | 1.08.00 2) | Cabling: Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 on the employers nearest trestle in the FGD area as shown in Drg no 0011-999-POC-F-001 subject to availability of space and suitability. In case of non-availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection & cable laying. | 1. Drg No. 0011-109-POE-F-001 is not available. Please provide.<br><br>2. Since there is a shortage of space in the Main plant area, separate structure/ trestle is not possible to connect the Main plant to FGD. Also it is an existing system, hence it is requested that laying of cable shall be done by the customer on nearest available trestle in FGD area. Where-ever there is no space in already running customer's trays, trays shall be provided by the bidder. Please confirm.<br><br>2. Runway conductor available in customer's trestle will be utilized for earthing purpose and bidder shall not lay runway conductor in areas where customer's runway conductor is already available. Only tapping from customer's run way conductor to cable trays supplied by bidder shall be in bidder's scope. Please confirm. | 1. refer to amendment<br><br>2. Bidder shall comply with technical specification requirement clause no: - 1.08.00.2.<br><br>3. Bidder can utilize employers run away conductor wherever available. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 186. | PART B/ SECTION-VI | II-E15 | 05 OF 16 | 4.00.00 3. | Lighting Masts | Number of Lighting Masts is not specified in the specification. Please confirm the minimum number | The same shall be decided during detailed engg. |
| 187. | PART B/ SECTION-VI & OOOD-209-POE·A-002 | II-E16 | 01 OF 13 & 11 OF 13 | 1.00.00 & 9.00.00 | Battery Health Monitoring System & DC Health Monitoring system | As per clause 1.00.00 DC health monitoring system shall be offered integral with each battery set for main plant and switchyard battery. We understand that Battery & DC health monitoring system is excluded from bidder's scope of supply for 220V DC Battery for FGD area. | Bidder's understanding is NOT correct. 220V DC Battery for FGD area shall be in the bidder's scope of supply and DC health monitoring system is not applicable for FGD area battery. |
| 188. | Drg No. 0011-109-POE-J-001/A-E | -- | -- | -- | Electrical Single line diagram | Electrical single line diagram for FGD plant for two units (2x800MW Darlipalli, 2x800MW Gadarwara and 2x800MW Lara) has been provided. Kindly also provide Electrical Single line diagram for FGD plant for Three units i.e. 3x800 MW Kudgi STPP. | Please refer Amendment to Technical Specifications(Section VI). |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 189. | PART C/ SECTION-VI | -- | 75 OF 83 | -- | GENERAL TECHNICAL REQUIREMENTS-Public Address system | Requirement of Public Address system is not mentioned anywhere in the specification except in this clause (Applicable code and standards for Public Address System) hence Public Address System is excluded from bidder's scope of supply for FGD area. Please confirm. | Public Address System is not in the scope of the bidder. |
| 190. | PART B/ SECTION-VI | II-E7 | 4 OF 6 | 2.16.01 | Cable selection & sizing : HT cable shall be sized based on the following considerations: a) Rated current of the equipment | For Incoming cable to 11kV Tie Switchgear in FGD area, sizing of cable shall be done as per actual loading of the switchboard. Please confirm. | Bidder shall comply with the technical specification |
| LAYOUT | | | | | | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 191. | Section –VI, Part-A | Sub Section- III-A1 | Page 7 of 9 | 14.00.00 | The contractor scope shall also include the provision of FGD trestle for routing of air & water lines, slurry lines, steam line, waste water, etc.. required for the complete process operations. | It is understood that pipe racks need to be constructed in new area for FGD requirement. However, existing pipe racks shall be used for routing pipes related to FGD system wherever need to do so arises.<br>Kindly confirm. | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles. |
| 192. | Section –VI, Part-A | Sub Section-III-A1 | Page 7 of 9 | 11.00.00 | Buildings | Please clarify whether various Equipment Cooling Water Auxiliaries of FGD system are to be kept in Pump house or shed. | Bidder shall provide Pump house. |
| COMPRESSED AIR SYSTEM | | | | | | | |
| 193. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 1 OF 7 | 1.01.00 | The compressed air system shall consist of ..... and **Unit Instrument air receivers (One for each Unit).** | Bidder understands that the scope of air receivers is as per technical specification Clause no. 3.00.00, Scope of supply & services, SECTION-VI / PART-A, Sub section-III-A2, page 3 of 4.<br>Separate Unit Instrument air receivers are not applicable.<br>Please confirm. | Bidder's understanding is correct. Bidder to refer relevant amendment for more clarity. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 194. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 1 OF 7 | 2.02.00 | Design and Construction – **For Compressor** | MOC of all components within compressor skid shall be as per OEM standard. The MOC and design of all components outside the skid shall be as per technical specification/NIT. This is being followed in all the projects executed by bidder for NTPC and other customers.<br>Please accept. | Bidder shall comply with specification requirement. However, any superior material may be accepted as per manufacturer proven design practice. |
| 195. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 2 OF 7 | 4.00.00 | Intercooler, Aftercooler & Oil coolers (For Screw) | | |
| 196. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 2 OF 7 | 3.01.00 | Air Compressor (Screw / **Centrifugal**)..... | Bidder have considered oil free Screw type compressor only in view of small rating. Centrifugal compressor for such small capacity compressors are not available. Customer to please note. | Noted. Bidder to refer relevant amendment . |
| 197. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 2 OF 7 | 3.04.00 | Compressor frame shall have **min. 10% extra capacity**. Compressor shall have **25% min. turndown capacity**. Compressor shall be provided with **IGV at the suction** flange. | Bidder have considered oil free Screw type compressor only. Hence this clause related to centrifugal type compressor shall not be applicable on Oil free screw compressor.<br>Please confirm. | Bidder to refer amendment. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 198. | SECTION-VI | I-M9 MDL | 21 OF 24 | 9.02.00 | SL. NO. 570<br>MQP OF LT MOTOR FOR AIR COMPRESSOR (ABB MAKE) | Please note that make of motor shall be as per NTPC approved makes for LT motor.<br>Please accept. | Bidder's understanding is correct. |
| 199. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(a) | Two numbers (1 W + 1S) oil free, rotary screw type air compressors for Instrument air & service air application for..... | 3.) Bidder understands that two number compressors shall be provided for the Station and not for individual unit. Please confirm.<br>4.) Also the common compressor is to be provided for Instrument air & Service application. NTPC to confirm whether the common piping network to be provided for Instrument air and Service air application for plant use or a separate network of Instrument air & Service air to be provided. Please clarify, as bidder have considered common piping network for IA & SA application. | Bidder's understanding is correct.<br>A separate network for IA and SA shall be provided.<br>Bidder to refer relevant Amendment. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 200. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(a) | The min. capacity of each air compressor shall be 15 Nm3/min..... | Bidder requests NTPC to accept the capacity of compressor as per design criteria given under cl. no. 9.01.00, Salient design data, SECTION-VI / PART-A, Sub section-V, page 20 of 26 OR compressor capacity of 15 Nm3/min whichever is lower.<br><br>Please confirm. | Bidder shall comply with specification requirement. |
| 201. | SECTION-VI / PART-A | V SALIENT DESIGN DATA & SIZING | 20 OF 26 | 9.01.00(a) | Air compressor shall be designed to meet the instrument air & service air requirement.....as per given formula | The formula for compressor sizing furnished by NTPC is not considering pneumatic air requirements for multiple nos. of Units for a particular project i.e. formula remain same for 1*660 MW,2*660 MW, 3*660 MW etc.<br><br>As the given formula is applicable for various projects, where in number of Units vary from 2 units to 4 units.<br><br>**Please clarify whether the same formula is to be used for all projects irrespective of number of units i.e. on station basis.** | Bidder's understanding is correct that Formula was given on **Station** basis. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 202. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(d) | One number air receiver of capacity 2m3 for ZLD…… | Bidder shall provide the air receiver for ZLD specifically where ZLD requirement is applicable for that project.<br>Please confirm. | Bidder's understanding is correct. |
| 203. | SECTION-VI / PART-A | IV TERMINAL POINTS & EXCLUSIONS | 3 OF 3 | 1.14.00(b) | Instrument air at one point (if required). | NTPC have asked for standalone compressed air system in order to meet the instrument air requirement for FGD.<br>Please clarify whether additional tapping from existing instrument air network shall also be provided for meeting instrument air requirement for FGD.<br>If yes, please furnish the coordinates for the terminal point. | Amendment will be issued in this regard. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 204. | SECTION-VI / PART-A | VI FUNCTIONAL GUARANTEES & LIQUIDITY DAMAGES | 22 OF 24 | xxiii | Total power consumption at motor input terminal at rated duty of air compressor…… | Bidder request NTPC to specify the duty factor for considering the auxiliary power consumption for Compressed air system. As the continuous consumption of compressed air will be much lesser than the rated compressor capacity specified by NTPC.<br>In such case, the compressor will go under unload conditions for a considerable time and thus lower power requirements. We request you to specify duty point for air compressors. | Duty point shall be 1.0 . Bidder shall comply with specification requirement. |
| 205. | SECTION-VI / PART-A | VI FUNCTIONAL GUARANTEES & LIQUIDITY DAMAGES | 19 OF 24 | xv | Compressed air system b.) Following shall be demonstrated at site. | Clause no. b(iii) is missing.<br><br>NTPC is requested to provide the same. | The clause b(iii) does not exist . |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 206. | SEC-TION-VI / PART-A | III-A2 AIR CONDI-TIONING, VENTI-LATION SYSTEM & COM-PRESSED AIR SYS-TEM | 3 OF 4 | 3.00.00 | Compressed air system | Clause no. 3.00.00(e) & 3.00.00(f) are missing.<br><br>NTPC is requested to provide the same. | Clause no. 3.00.00(e) & 3.00.00(f) does not exist. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | **HOISTS** | | |
| 207. | SEC VI, PART-B | I-M1 | 35 OF 51 | 14.09.00 | Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more.<br>Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc. | Referred clauses are contradictory w.r.t selection of electric or manual hoist. We shall follow clause 10.09.00 of sub-section V/Section VI Part A for selection of electric or manual hoist.<br><br>Kindly confirm. | Bidder shall comply with the requirements of Technical Specification.<br><br>The referred clauses of technical specifications are very clear and pertains to the requirements of Limestone Handling System & Gypsum Handling System and shall be read independent of the hoist requirement brought out in Sub-section I-M1, Section VI, Part-B. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION RE-QUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 208. | SEC VI, PART-B | I-M6 | 6 OF 73 | 4.3.2 | For the hoists with more than 2.0 tonne lifting capacity or more than 10.0 m lift with the exception of hoists for GTU & bend pulleys motor operated hoist blocks for both long travel & lift shall be provided. | | The referred clauses of technical specifications are very clear and pertains to the requirements of Limestone Handling System & Gypsum Handling System and shall be read independent of the hoist requirement brought out in Sub-section I-M1, Section VI, Part-B. |
| 209. | Section-VI, PART-A | Sub-Section-V | 23 OF 26 | 10.09.00 | Hoists<br>Drive<br>(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings<br>(ii) Other hoists includ-ing the hoists for han-dling take-up pulley and take-up weight | | The referred clauses of technical specifications are very clear and pertains to the requirements of Limestone Handling System & Gypsum Handling System and shall be read independent of the hoist requirement brought out in Sub-section I-M1, Section VI, Part-B. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 210. | Section-VI, PART-B | I-M1 | 35 OF 51 | 14.09.00 | Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. | Considering the layout & space constraints, it may not be feasible to provide all electric hoists with maintenance / repair platforms with handrails. Hence maintenance platform shall be provided depending upon feasibility.<br><br>Please Confirm. | Specification requirement is clear in this regard. Bidder shall comply with the specification requirements |
| 211. | Section-VI, PART-A | Sub-Section-VII | 18 OF 61 | A-10 | MANDATORY SPARES:<br><br>Spares for Electrically operated hoist for FGD WWT system for ZLD (for each type & size) | 3) Mandatory spares of Electric hoists have been mentioned under these two referred clauses/ areas only. Kindly clarify whether Mandatory spares are to be considered for Electric Hoists in area, other than speci- | Bidder shall comply with the specification requirements given under the clauses referring to the equipment under the sub section VII. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 212. | Section-VI, PART-A | Sub-Section-VII | 39 OF 61 | K | Mandatory Spares of Limestone & Gypsum Handling:<br>ELECTRIC HOISTS | fied in referred clause. In case the same has to be considered, then kindly inform about applicable list of mandatory spares to be followed.<br><br>4) Further, no spares are mentioned for chain pulley blocks. We understand that no spares shall be provided for chain pulley blocks.<br>Please confirm. | Confirmed. |
| | | | | | **CIVIL** | | |
| 213. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 214. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 215. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 216. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 217. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall neces-sarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopt-ed (Brick Cladding / Metal Sheet Clad-ding). | Refer Sl.No.81 |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 218. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Refer Sl.No.82 |
| 219. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 220. | VI/A | II-A4 | 10 of 30 | 7.00.01 | Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV. | Annexure-IV is not available in the specification. Please provide the same. | Bidder to refer amendment |
| 221. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | External surface of the chimney flue liner projecting over the chimney roof shall be wrapped with 2mm thick titanium/ C276 sheet over insulation. | These clauses are contradictory.<br>Bidder understands that if 2mm thick titanium/ C276 sheet wrapping over insulation is provided then no painting is required on external surface of the chimney flue liner projecting over the chimney roof.<br>Please confirm. | No painting is required on external surface of chimney flue liner projecting above chimney roof. Also refer Amendment in this regard. |
| 222. | SEC VI / PART B | IV D | 15 OF 69 | 3.14.09 (iv) | ....., external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. | | |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 223. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. | | |
| 224. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Bidder understands that cladding can be done with explosion bonding or hot rolling or combination of both to achieve the required quality as per ASTM B 898-11.<br>Please confirm. | Bidder shall provide the proposed cladding methods as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 225. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | | |
| 226. | SEC VI / PART B | IV D | 39 OF 69 | 20.00.00 | Electrodes | Please provide the detail/type of electrodes to be used in welding of titanium/C276. | Type of electrode will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval. |
| 227. | SEC VI / PART B | IV D | 39 OF 69 | 20.07.00 | Edge Preparation for Welding | Please provide edge preparation detail for titanium/C276 material. | Edge Preparation detail will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval. |

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| 228. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (mini-mum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Please provide the material code to be followed for alloy C-276. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 229. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (mini-mum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | | |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 230. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Kindly furnish the following specifications for chimney liners.<br>1. Permissible tolerances on thickness of clad sheet and base material.<br>2. Permissible tolerances on flatness for clad sheet and base material.<br>3. Specify the quality tests which will be conducted on the clad sheet for assessing mechanical and chemical properties and on the chimney cans after fabrication.<br>4. Indicate any special requirements applicable for welding and fabrication of chimney at site.<br>5. Indicate any restriction in size of base metal and clad plate to be used for fabrication of flue cans.<br>6. Mention tensile and yield strength of the cladded material to be achieved. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 231. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | | |

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| 232. | SEC VI / PART A | I | 10 OF 19 | 4.02.03 | For Chimney, Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height. | Bidder understands that, there is no other prequalification requirements related to fabrication and erection of titanium/ c276 cladded steel flue liner in chimney. Please confirm. | Bidder's understanding is Correct. |
| 233. | SEC VI / PART B | IV D | 2 OF 69 | 2.03.00 | Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height. | | |
| 234. | VI / A | V | 8 OF 26 | 5.01.00 | A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor... | The location of new Wet Chimney shall be near to Existing Chimney in the space provided clearing foundation interface. The design of Wet Chimney shall be done considering interface factor of existing chimney as determined by wind tunnel study. However, no design check or validation shall be done for existing chimney/structures/buildings. Kindly confirm. | It is confirmed that no design check or validation shall be done by the bidder for existing chimney(s). |

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| | | | | C&I | | | |
| 235. | Section VI/Part-A | Sub-Section VII | Page 13 of 61<br><br>Page 19 of 61 | Clause 1.19.00<br><br>Clause 1.21.00 | Mandatory spares-AC & Ventilation system (Control & Instrumentation) | C&I Mandatory spares for AC & Ventilation are covered in both clauses and are repeated also. Only Clause 1.19.00 (3) will be considered for C&I spares. Please confirm. | Refer amendment in this regard. The referred clause 1.19.00 stands deleted. Bidder to refer relevant amendment in this regard. |

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| 236. | Section VI/Part-A | Sub-Section VII | Page 45 of 61 | Clause 1.25.00 | Mandatory spares-(Control & Instrumentation) | C&I mandatory spares for AC & ventilation system and Compressed air system shall be provided as per clause 1.19.00 and 1.23.00 respectively. Mandatory Spares mentioned under Clause 1.25.00 shall not be applicable for above mentioned packages. Please confirm. | Refer amendment in this regard. |
| | | | | | **ELECTRICAL** | | |
| 237. | PART B/ SECTION-VI | II-E1 | 4 OF 7 | 2.05.00 | Control Philosophy | Control of 11kV breakers (from 11kV station switchboards) from customer's DDCMIS shall be in customer's scope. Any change of logics in customer's existing control panel or DCS shall be arranged by the customer. Please confirm. | Please refer Amendment to Technical Specifications(Section VI).<br>a) "All switchgears and MCCs shall be controlled from PLC/DCS. |

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| 238. | Drg No. 0011-109-POE-J-001/A-E | PART E | | Note No. 10 of Drg No. 0011-109-POE-J-001/A-E | Two number 11kV.....of bidder. | 1. It is clarified that necessary augmentation and modification required in customer's 11kV SWGR for two no. 11 kV motors per unit from existing spare feeder from station swbd shall be done by the customer. Please confirm.<br><br>2. Please also confirm that the feeding arrangement is also indicative and the actual arrangement of boards/ number of boards can be changed/ altered during the detailed engineering by the bidder based on the actual loads. | Please refer Amendment to Technical Specifications (Section VI). |

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| 239. | Drg No. 0011-109-POE-J-001/A-E | -- | -- | Note No. 11 | Panel being used.....scope of bidder. | 1. Cables & Cabling (Cable trays, tray supports, termination & jointing kits, clamps etc.) for these two 11kV HT feeders shall be in customer scope & is excluded from bidder's scope of supply & erection. Please Confirm.<br><br>2. Customer is requested to provide load (kVA) details for existing CHP/AHP along with any other load/feeder requirement for owner's use (if any). | Please refer Amendment to Technical Specifications (Section VI). |

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| 240. | PART A/ SECTION-VI | IIIB | 2 OF 6 | 1.08.00 2) | Cabling: Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 on the employers nearest trestle in the FGD area as shown in Drg no 0011-999-POC-F-001 subject to availability of space and suitability. In case of non-availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection & cable laying. | 1. Drg No. 0011-109-POE-F-001 is not available. Please provide.<br><br>2. Since there is a shortage of space in the Main plant area, separate structure/ trestle is not possible to connect the Main plant to FGD. Also it is an existing system, hence it is requested that laying of cable shall be done by the customer on nearest available trestle in FGD area. Where-ever there is no space in already running customer's trays, trays shall be provided by the bidder. Please confirm.<br><br>2. Runway conductor available in customer's trestle will be utilized for earthing purpose and bidder shall not lay runway conductor in areas where customer's runway conductor is already available. Only tapping from customer's run way conductor to cable trays supplied by bidder shall be in bidder's scope. Please confirm. | 1. refer to amendment no<br><br>2. Bidder shall comply with technical specification requirement clause no: - 1.08.00.2.<br><br>3. Bidder can utilize employers run away conductor wherever available. |

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| 241. | PART B/ SECTION-VI | II-E15 | 05 OF 16 | 4.00.00 3. | Lighting Masts | Number of Lighting Masts is not specified in the specification. Please confirm the minimum number | The same shall be decided during detailed engg. |
| 242. | PART B/ SECTION-VI & OOOD-209-POE·A-002 | II-E16 | 01 OF 13 & 11 OF 13 | 1.00.00 & 9.00.00 | Battery Health Monitoring System & DC Health Monitoring system | As per clause 1.00.00 DC health monitoring system shall be offered integral with each battery set for main plant and switchyard battery. We understand that Battery & DC health monitoring system is excluded from bidder's scope of supply for 220V DC Battery for FGD area. | Bidder's understanding is NOT correct. 220V DC Battery for FGD area shall be in the bidder's scope of supply and DC health monitoring system is not applicable for FGD area battery. |
| 243. | Drg No. 0011-109-POE-J-001/A-E | -- | -- | -- | Electrical Single line diagram | Electrical single line diagram for FGD plant for two units (2x800MW Darlipalli, 2x800MW Gadarwara and 2x800MW Lara) has been provided. Kindly also provide Electrical Single line diagram for FGD plant for Three units i.e. 3x800 MW Kudgi STPP. | Please refer Amendment to Technical Specifications(Section VI). |

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| 244. | PART C/ SECTION- VI | -- | 75 OF 83 | -- | GENERAL TECHNICAL REQUIREMENTS-Public Address system | Requirement of Public Address system is not mentioned anywhere in the specification except in this clause (Applicable code and standards for Public Address System) hence Public Address System is excluded from bidder's scope of supply for FGD area. Please confirm. | Public Address System is not in the scope of the bidder. |
| 245. | PART B/ SECTION- VI | II-E7 | 4 OF 6 | 2.16.01 | Cable selection & sizing : HT cable shall be sized based on the following considerations: a) Rated current of the equipment | For Incoming cable to 11kV Tie Switchgear in FGD area, sizing of cable shall be done as per actual loading of the switchboard. Please confirm. | Bidder shall comply with the technical specification |
| **LAYOUT** | | | | | | | |
| 246. | Section –VI, Part-A | Sub Section- III-A1 | Page 7 of 9 | 14.00.00 | The contractor scope shall also include the provision of FGD trestle for routing of air & water lines, slurry lines, steam line, waste water, etc.. required for the complete process operations. | It is understood that pipe racks need to be constructed in new area for FGD requirement. However, existing pipe racks shall be used for routing pipes related to FGD system wherever need to do so arises.<br>Kindly confirm. | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles. |

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| 247. | Section –VI, Part-A | Sub Section-III-A1 | Page 7 of 9 | 11.00.00 | Buildings | Please clarify whether various Equipment Cooling Water Auxiliaries of FGD system are to be kept in Pump house or shed. | Bidder shall provide Pump house. |
| **COMPRESSED AIR SYSTEM** | | | | | | | |
| 248. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 1 OF 7 | 1.01.00 | The compressed air system shall consist of ..... and **Unit Instrument air receivers (One for each Unit).** | Bidder understands that the scope of air receivers is as per technical specification Clause no. 3.00.00, Scope of supply & services, SECTION-VI / PART-A, Sub section-III-A2, page 3 of 4. Separate Unit Instrument air receivers are not applicable. Please confirm. | Bidder's understanding is correct. Bidder to refer relevant amendment for more clarity. |
| 249. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 1 OF 7 | 2.02.00 | Design and Construction – **For Compressor** | MOC of all components within compressor skid shall be as per OEM standard. The MOC and design of all components outside the skid shall be as per technical specification/NIT. This is being followed in all the projects executed by bidder for NTPC and other customers. Please accept. | Bidder shall comply with specification requirement. However, any superior material may be accepted as per manufacturer proven design practice. |
| 250. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 2 OF 7 | 4.00.00 | Intercooler, Aftercooler & Oil coolers (For Screw) | | |

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| 251. | SECTION-VI / PART-B | I-M3 COM-PRESSED AIR SYSTEM | 2 OF 7 | 3.01.00 | Air Compressor (Screw / **Centrifugal**)..... | Bidder have considered oil free Screw type compressor only in view of small rating. Centrifugal compressor for such small capacity compressors are not available. Customer to please note. | Noted. Bidder to refer relevant amendment . |
| 252. | SECTION-VI / PART-B | I-M3 COM-PRESSED AIR SYSTEM | 2 OF 7 | 3.04.00 | Compressor frame shall have **min. 10% extra capacity**. Compressor shall have **25% min. turndown capacity**. Compressor shall be provided with **IGV at the suction** flange. | Bidder have considered oil free Screw type compressor only. Hence this clause related to centrifugal type compressor shall not be applicable on Oil free screw compressor.<br>Please confirm. | Bidder to refer amendment. |
| 253. | SECTION-VI | I-M9 MDL | 21 OF 24 | 9.02.00 | SL. NO. 570<br>MQP OF LT MOTOR FOR AIR COMPRESSOR (ABB MAKE) | Please note that make of motor shall be as per NTPC approved makes for LT motor.<br>Please accept. | Bidder's understanding is correct. |

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| 254. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(a) | Two numbers (1 W + 1S) oil free, rotary screw type air compressors for Instrument air & service air application for…… | 5.) Bidder understands that two number compressors shall be provided for the Station and not for individual unit. Please confirm.<br>6.) Also the common compressor is to be provided for Instrument air & Service application. NTPC to confirm whether the common piping network to be provided for Instrument air and Service air application for plant use or a separate network of Instrument air & Service air to be provided. Please clarify, as bidder have considered common piping network for IA & SA application. | Bidder's understanding is correct. A separate network for IA and SA shall be provided. Bidder to refer relevant Amendment. |
| 255. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(a) | The min. capacity of each air compressor shall be 15 Nm3/min……. | Bidder requests NTPC to accept the capacity of compressor as per design criteria given under cl. no. 9.01.00, Salient design data, SECTION-VI / PART-A, Sub section-V, page 20 of 26 OR compressor capacity of 15 Nm3/min whichever is lower.<br><br>Please confirm. | Bidder shall comply with specification requirement. |

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| 256. | SECTION-VI / PART-A | V SALIENT DESIGN DATA & SIZING | 20 OF 26 | 9.01.00(a) | Air compressor shall be designed to meet the instrument air & service air requirement.....as per given formula | The formula for compressor sizing furnished by NTPC is not considering pneumatic air requirements for multiple nos. of Units for a particular project i.e. formula remain same for 1*660 MW,2*660 MW, 3*660 MW etc.<br><br>As the given formula is applicable for various projects, where in number of Units vary from 2 units to 4 units.<br><br>**Please clarify whether the same formula is to be used for all projects irrespective of number of units i.e. on station basis.** | Bidder's understanding is correct that Formula was given on **Station** basis. |
| 257. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(d) | One number air receiver of capacity 2m3 for ZLD..... | Bidder shall provide the air receiver for ZLD specifically where ZLD requirement is applicable for that project.<br>Please confirm. | Bidder's understanding is correct. |

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| 258. | SECTION-VI / PART-A | IV TERMINAL POINTS & EXCLU-SIONS | 3 OF 3 | 1.14.00(b) | Instrument air at one point (if required). | NTPC have asked for standalone compressed air system in order to meet the instrument air requirement for FGD.<br>Please clarify whether additional tapping from existing instrument air network shall also be provided for meeting instrument air requirement for FGD.<br>If yes, please furnish the coordinates for the terminal point. | Amendment will be issued in this regard. |
| 259. | SECTION-VI / PART-A | VI FUNCTIONAL GUARANTEES & LIQUIDITY DAMAGES | 22 OF 24 | xxiii | Total power consumption at motor input terminal at rated duty of air compressor…… | Bidder request NTPC to specify the duty factor for considering the auxiliary power consumption for Compressed air system. As the continuous consumption of compressed air will be much lesser than the rated compressor capacity specified by NTPC.<br>In such case, the compressor will go under unload conditions for a considerable time and thus lower power requirements. We request you to specify duty point for air compressors. | Duty point shall be 1.0 . Bidder shall comply with specification requirement. |

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| 260. | SECTION-VI / PART-A | VI FUNCTION-AL GUAR-ANTEES & LIQUIDITY DAMAGES | 19 OF 24 | xv | Compressed air system<br>b.) Following shall be demonstrated at site. | Clause no. b(iii) is missing.<br><br>NTPC is requested to provide the same. | The clause b(iii) does not exist . |

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| 261. | SECTION-VI / PART-A | III-A2 AIR CONDI-TIONING, VENTILA-TION SYS-TEM & COM-PRESSED AIR SYSTEM | 3 OF 4 | 3.00.00 | Compressed air system | Clause no. 3.00.00(e) & 3.00.00(f) are missing.<br><br>NTPC is requested to provide the same. | Clause no. 3.00.00(e) & 3.00.00(f) does not exist. |

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| | | | | | **HOISTS** | | |
| 262. | SEC VI, PART-B | I-M1 | 35 OF 51 | 14.09.00 | Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more.<br>Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc. | Referred clauses are contradictory w.r.t selection of electric or manual hoist. We shall follow clause 10.09.00 of sub-section V/Section VI Part A for selection of electric or manual hoist.<br><br>Kindly confirm. | |
| 263. | SEC VI, PART-B | I-M6 | 6 OF 73 | 4.3.2 | For the hoists with more than 2.0 tonne lifting capacity or more than 10.0 m lift with the exception of hoists for GTU & bend pulleys motor operated hoist blocks for both long travel & lift shall be provided. | | The referred clauses of technical specifications are very clear and pertains to the requirements of Limestone Handling System & Gypsum Handling System and shall be read independent of the hoist requirement brought out in Subsection I-M1, Section VI, Part-B. |

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| 264. | Section-VI, PART-A | Sub-Section-V | 23 OF 26 | 10.09.00 | Hoists<br>Drive<br>(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings<br>(ii) Other hoists including the hoists for handling take-up pulley and take-up weight | | The referred clauses of technical specifications are very clear and pertains to the requirements of Limestone Handling System & Gypsum Handling System and shall be read independent of the hoist requirement brought out in Sub-section I-M1, Section VI, Part-B. |
| 265. | Section-VI, PART-B | I-M1 | 35 OF 51 | 14.09.00 | Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. | Considering the layout & space constraints, it may not be feasible to provide all electric hoists with maintenance / repair platforms with handrails. Hence maintenance platform shall be provided depending upon feasibility.<br><br>Please Confirm. | Specification requirement is clear in this regard. Bidder shall comply with the specification requirements |

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| 266. | Section-VI, PART-A | Sub-Section-VII | 18 OF 61 | A-10 | MANDATORY SPARES:<br><br>Spares for Electrically operated hoist for FGD WWT system for ZLD (for each type & size) | 5) Mandatory spares of Electric hoists have been mentioned under these two referred clauses/ areas only. Kindly clarify whether Mandatory spares are to be considered for Electric Hoists in area, other than specified in referred clause. In case the same has to be considered, then kindly inform about applicable list of mandatory spares to be followed.<br><br>6) Further, no spares are mentioned for chain pulley blocks. We understand that no spares shall be provided for chain pulley blocks. Please confirm. | Bidder shall comply with the specification requirements given under the clauses referring to the equipment under the sub section VII.<br><br>Confirmed. |
| 267. | Section-VI, PART-A | Sub-Section-VII | 39 OF 61 | K | Mandatory Spares of Limestone & Gypsum Handling: ELECTRIC HOISTS | | |
| **CIVIL** | | | | | | | |

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| 268. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 269. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Layout plan |
| 270. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately. |

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| 271. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately. |
| 272. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Refer Sl.No.81 |

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| 273. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Refer Sl.No.82 |
| 274. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | |

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| 275. | VI/A | II-A3 | 22 OF 31 | Annexure-IV, e) | The minimum pile length for each group of piles shall be determined based on the nearest bore log. A minimum embedment of 2.0m into pebbles/cobbles/boulder strata (river Bed material) as observed in such bore log shall be ensured, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby bore log data. | The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm. | Bidder shall comply the provisions of technical specification. |

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| 276. | VI/A | II-A3 | 14 OF 31 | 7.02.03 xv | High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. | High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm. | Bidder may conduct either static routine load test or high strain dynamic load test.<br>Refer amendment . |

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| 277. | General | - | - | - | - | Lab test results of geotechnical investigation may please be furnished. | Bidder to refer amendment. |
| 278. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | External surface of the chimney flue liner projecting over the chimney roof shall be wrapped with 2mm thick titanium/ C276 sheet over insulation. | These clauses are contradictory. Bidder understands that if 2mm thick titanium/ C276 sheet wrapping over insulation is provided then no painting is required on external surface of the chimney flue liner projecting over the chimney roof. Please confirm. | No painting is required on external surface of chimney flue liner projecting above chimney roof. Also refer Amendment in this regard. |
| 279. | SEC VI / PART B | IV D | 15 OF 69 | 3.14.09 (iv) | ....., external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. | | |
| 280. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. | | |

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| 281. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Bidder understands that cladding can be done with explosion bonding or hot rolling or combination of both to achieve the required quality as per ASTM B 898-11.<br>Please confirm. | Bidder shall provide the proposed cladding methods as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements. |
| 282. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | | Bidder shall provide the proposed cladding methods as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements. |
| 283. | SEC VI / PART B | IV D | 39 OF 69 | 20.00.00 | Electrodes | Please provide the detail/type of electrodes to be used in welding of titanium/C276. | Type of electrode will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval. |

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| 284. | SEC VI / PART B | IV D | 39 OF 69 | 20.07.00 | Edge Preparation for Welding | Please provide edge preparation detail for titanium/C276 material. | Edge Preparation detail will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval. |
| 285. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Please provide the material code to be followed for alloy C-276. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 286. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | | |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 287. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Kindly furnish the following specifications for chimney liners.<br>1. Permissible tolerances on thickness of clad sheet and base material.<br>2. Permissible tolerances on flatness for clad sheet and base material.<br>3. Specify the quality tests which will be conducted on the clad sheet for assessing mechanical and chemical properties and on the chimney cans after fabrication.<br>4. Indicate any special requirements applicable for welding and fabrication of chimney at site.<br>5. Indicate any restriction in size of base metal and clad plate to be used for fabrication of flue cans.<br>6. Mention tensile and yield strength of the cladded material to be achieved. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 288. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | | Bidder's understanding is Correct. |
| 289. | SEC VI / PART A | I | 10 OF 19 | 4.02.03 | For Chimney, Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height. | Bidder understands that, there is no other prequalification requirements related to fabrication and erection of titanium/ c276 cladded steel flue liner in chimney.<br>Please confirm. | Bidder's understanding is Correct. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 290. | SEC VI / PART B | IV D | 2 OF 69 | 2.03.00 | Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height. | | |
| 291. | VI / A | V | 8 OF 26 | 5.01.00 | A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor... | The location of new Wet Chimney shall be near to Existing Chimney in the space provided clearing foundation interface. The design of Wet Chimney shall be done considering interface factor of existing chimney as determined by wind tunnel study. However, no design check or validation shall be done for existing chimney/structures/buildings. Kindly confirm. | It is confirmed that no design check or validation shall be done by the bidder for existing chimney(s). |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| | | | | | **C&I** | | |
| 292. | Section VI/Part-A | Sub-Section VII | Page 13 of 61<br><br>Page 19 of 61 | Clause 1.19.00<br><br>Clause 1.21.00 | Mandatory spares-<br>AC & Ventilation system (Control & Instrumentation) | C&I Mandatory spares for AC & Ventilation are covered in both clauses and are repeated also. Only Clause 1.19.00 (3) will be considered for C&I spares. Please confirm. | Refer amendment in this regard. The referred clause 1.19.00 stands deleted. Bidder to refer relevant amendment in this regard. |
| 293. | Section VI/Part-A | Sub-Section VII | Page 45 of 61 | Clause 1.25.00 | Mandatory spares-<br>(Control & Instrumentation) | C&I mandatory spares for AC & ventilation system and Compressed air system shall be provided as per clause 1.19.00 and 1.23.00 respectively. Mandatory Spares mentioned under Clause 1.25.00 shall not be applicable for above mentioned packages. Please confirm. | Refer amendment in this regard. |
| | | | | | **ELECTRICAL** | | |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 294. | PART B/ SECTION- VI | II-E1 | 4 OF 7 | 2.05.00 | Control Philosophy | Control of 11kV breakers (from 11kV station switchboards) from customer's DDCMIS shall be in customer's scope. Any change of logics in customer's existing control panel or DCS shall be arranged by the customer. Please confirm. | Please refer Amendment to Technical Specifications(Section VI).<br><br>a) "All switchgears and MCCs shall be controlled from PLC/DCS. |

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| | | | | | **C&I** | | |
| 295. | Section VI/Part-A | Sub-Section VII | Page 13 of 61<br><br>Page 19 of 61 | Clause 1.19.00<br><br>Clause 1.21.00 | Mandatory spares-<br>AC & Ventilation system (Control & Instrumentation) | C&I Mandatory spares for AC & Ventilation are covered in both clauses and are repeated also. Only Clause 1.19.00 (3) will be considered for C&I spares. Please confirm. | Refer amendment in this regard.<br>The referred clause 1.19.00 stands deleted. Bidder to refer relevant amendment in this regard. |
| 296. | Section VI/Part-A | Sub-Section VII | Page 45 of 61 | Clause 1.25.00 | Mandatory spares-<br>(Control & Instrumentation) | C&I mandatory spares for AC & ventilation system and Compressed air system shall be provided as per clause 1.19.00 and 1.23.00 respectively. Mandatory Spares mentioned under Clause 1.25.00 shall not be applicable for above mentioned packages. Please confirm. | Refer amendment in this regard. |
| | | | | | **ELECTRICAL** | | |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 297. | PART B/ SEC-TION- VI | II-E1 | 4 OF 7 | 2.05.00 | Control Philosophy | Control of 11kV breakers (from 11kV station switchboards) from customer's DDCMIS shall be in customer's scope. Any change of logics in customer's existing control panel or DCS shall be arranged by the customer. Please confirm. | Please refer Amendment to Technical Specifications(Section VI).<br><br>a) "All switchgears and MCCs shall be controlled from PLC/DCS. |
| 298. | Drg No. 0011-109-POE-J-001/A-E | PART E | | Note No. 10 of Drg No. 0011-109-POE-J-001/A-E | Two number 11kV.....of bidder. | 1. It is clarified that necessary augmentation and modification required in customer's 11kV SWGR for two no. 11 kV motors per unit from existing spare feeder from station swbd shall be done by the customer. Please confirm.<br><br>2. Please also confirm that the feeding arrangement is also indicative and the actual arrangement of boards/ number of boards can be changed/ altered during the detailed engineering by the bidder based on the actual loads. | Please refer Amendment to Technical Specifications(Section VI). |

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| 299. | Drg No. 0011-109-POE-J-001/A-E | -- | -- | Note No. 11 | Panel being used.....scope of bidder. | 1. Cables & Cabling (Cable trays, tray supports, termination & jointing kits, clamps etc.) for these two 11kV HT feeders shall be in customer scope & is excluded from bidder's scope of supply & erection. Please Confirm.<br><br>2. Customer is requested to provide load (kVA) details for existing CHP/AHP along with any other load/feeder requirement for owner's use (if any). | Please refer Amendment to Technical Specifications(Section VI). |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 300. | PART A/ SEC-TION- VI | IIIB | 2 OF 6 | 1.08.00 2) | Cabling: Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 on the employers nearest trestle in the FGD area as shown in Drg no 0011-999-POC-F-001 subject to availability of space and suitability. In case of non-availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection & cable laying. | 1. Drg No. 0011-109-POE-F-001 is not available. Please provide.<br><br>2. Since there is a shortage of space in the Main plant area, separate structure/ trestle is not possible to connect the Main plant to FGD. Also it is an existing system, hence it is requested that laying of cable shall be done by the customer on nearest available trestle in FGD area. Where-ever there is no space in already running customer's trays, trays shall be provided by the bidder. Please confirm.<br><br>2. Runway conductor available in customer's trestle will be utilized for earthing purpose and bidder shall not lay runway conductor in areas where customer's runway conductor is already available. Only tapping from customer's run way conductor to cable trays supplied by bidder shall be in bidder's scope. Please confirm. | 1. Bidder to refer necessary amendment in this regard.<br><br>2. Bidder shall comply with technical specification requirement clause no: - 1.08.00.2.<br><br>3. Bidder can utilize employers run away conductor wherever available. |

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| 301. | PART B/ SEC-TION- VI | II-E15 | 05 OF 16 | 4.00.00 3. | Lighting Masts | Number of Lighting Masts is not specified in the specification. Please confirm the minimum number | Bidder shall provide LMs as per technical specification require-ments. Quantity shall be decid-ed during detail engineering. |
| 302. | PART B/ SEC-TION- VI & OOOD-209-POE·A-002 | II-E16 | 01 OF 13 & 11 OF 13 | 1.00.00 & 9.00.00 | Battery Health Monitoring System & DC Health Monitoring system | As per clause 1.00.00 DC health monitoring system shall be of-fered integral with each battery set for main plant and switchyard battery. We understand that Bat-tery & DC health monitoring sys-tem is excluded from bidder's scope of supply for 220V DC Bat-tery for FGD area. | Bidder's understanding is NOT correct. 220V DC Battery for FGD area shall be in the bidder's scope of supply and DC health monitoring system is not appli-cable for FGD area battery. |
| 303. | Drg No. 0011-109-POE-J-001/A-E | -- | -- | -- | Electrical Single line diagram | Electrical single line diagram for FGD plant for two units (2x800MW Darlipalli, 2x800MW Gadarwara and 2x800MW Lara) has been provided. Kindly also provide Electrical Single line dia-gram for FGD plant for Three units i.e. 3x800 MW Kudgi STPP. | Refer amendment to technical specifications wherein SLD for FGD system for all unit configu-rations have been provided. |

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| 304. | PART C/ SEC-TION- VI | -- | 75 OF 83 | -- | GENERAL TECHNICAL REQUIRE-MENTS-Public Address system | Requirement of Public Address system is not mentioned any-where in the specification except in this clause (Applicable code and standards for Public Address System) hence Public Address System is excluded from bidder's scope of supply for FGD area. Please confirm. | Public Address System is not in the scope of the bidder. |
| 305. | PART B/ SEC-TION- VI | II-E7 | 4 OF 6 | 2.16.01 | Cable selection & sizing : HT cable shall be sized based on the follow-ing considerations: a) Rated cur-rent of the equipment | For Incoming cable to 11kV Tie Switchgear in FGD area, sizing of cable shall be done as per actual loading of the switchboard. Please confirm. | Bidder shall comply with the technical specification |
| LAYOUT | | | | | | | |

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| 306. | Section –VI, Part-A | Sub Section- III-A1 | Page 7 of 9 | 14.00.00 | The contractor scope shall also include the provision of FGD trestle for routing of air & water lines, slurry lines, steam line, waste water, etc.. required for the complete process operations. | It is understood that pipe racks need to be constructed in new area for FGD requirement. However, existing pipe racks shall be used for routing pipes related to FGD system wherever need to do so arises.<br>Kindly confirm. | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles. |
| 307. | Section –VI, Part-A | Sub Section-III-A1 | Page 7 of 9 | 11.00.00 | Buildings | Please clarify whether various Equipment Cooling Water Auxiliaries of FGD system are to be kept in Pump house or shed. | Bidder shall provide Pump house. |
| | | | | | **COMPRESSED AIR SYSTEM** | | |
| 308. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 1 OF 7 | 1.01.00 | The compressed air system shall consist of ..... and **Unit Instrument air receivers (One for each Unit).** | Bidder understands that the scope of air receivers is as per technical specification Clause no. 3.00.00, Scope of supply & services, SECTION-VI / PART-A, Sub section-III-A2, page 3 of 4.<br>Separate Unit Instrument air receivers are not applicable.<br>Please confirm. | Bidder's understanding is correct. Bidder to refer relevant amendment for more clarity. |
| 309. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 1 OF 7 | 2.02.00 | Design and Construction – **For Compressor** | MOC of all components within compressor skid shall be as per OEM standard. The MOC and design of all components outside the skid shall be as per technical | Bidder shall comply with specification requirement. However, any superior material may be accepted as per manufacturer proven design practice. |

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| 310. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 2 OF 7 | 4.00.00 | Intercooler, Aftercooler & Oil coolers (For Screw) | specification/NIT. This is being followed in all the projects executed by bidder for NTPC and other customers.<br>Please accept. | |
| 311. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 2 OF 7 | 3.01.00 | Air Compressor (Screw / **Centrifugal**)..... | Bidder have considered oil free Screw type compressor only in view of small rating. Centrifugal compressor for such small capacity compressors are not available.<br>Customer to please note. | Noted. Bidder to refer relevant amendment . |
| 312. | SECTION-VI / PART-B | I-M3 COMPRESSED AIR SYSTEM | 2 OF 7 | 3.04.00 | Compressor frame shall have **min. 10% extra capacity**. Compressor shall have **25% min. turndown capacity**. Compressor shall be provided with **IGV at the suction** flange. | Bidder have considered oil free Screw type compressor only. Hence this clause related to centrifugal type compressor shall not be applicable on Oil free screw compressor.<br>Please confirm. | Bidder to refer amendment. |
| 313. | SECTION-VI | I-M9 MDL | 21 OF 24 | 9.02.00 | SL. NO. 570<br>MQP OF LT MOTOR FOR AIR COMPRESSOR (ABB MAKE) | Please note that make of motor shall be as per NTPC approved makes for LT motor.<br>Please accept. | |

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| 314. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(a) | Two numbers (1 W + 1S) oil free, rotary screw type air compressors for Instrument air & service air application for..... | 7.) Bidder understands that two number compressors shall be provided for the Station and not for individual unit. Please confirm.<br>8.) Also the common compressor is to be provided for Instrument air & Service application. NTPC to confirm whether the common piping network to be provided for Instrument air and Service air application for plant use or a separate network of Instrument air & Service air to be provided. Please clarify, as bidder have considered common piping network for IA & SA application. | Bidder's understanding is correct.<br>A separate network for IA and SA shall be provided.<br>Bidder to refer relevant Amendment. |

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| 315. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(a) | The min. capacity of each air compressor shall be 15 Nm3/min..... | Bidder requests NTPC to accept the capacity of compressor as per design criteria given under cl. no. 9.01.00, Salient design data, SECTION-VI / PART-A, Sub section-V, page 20 of 26 OR compressor capacity of 15 Nm3/min whichever is lower.<br><br>Please confirm. | Bidder shall comply with specification requirement. |

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| 316. | SEC-TION-VI / PART-A | V SALIENT DESIGN DATA & SIZING | 20 OF 26 | 9.01.00(a) | Air compressor shall be designed to meet the instrument air & service air requirement.....as per given formula | The formula for compressor sizing furnished by NTPC is not considering pneumatic air requirements for multiple nos. of Units for a particular project i.e. formula remain same for 1*660 MW,2*660 MW, 3*660 MW etc.<br><br>As the given formula is applicable for various projects, where in number of Units vary from 2 units to 4 units.<br><br>**Please clarify whether the same formula is to be used for all projects irrespective of number of units i.e. on station basis.** | Bidder's understanding is correct that Formula was given on **Station** basis. |

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| 317. | SECTION-VI / PART-A | III-A2 AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 3 OF 4 | 3.00.00(d) | One number air receiver of capacity 2m3 for ZLD..... | Bidder shall provide the air receiver for ZLD specifically where ZLD requirement is applicable for that project.<br>Please confirm. | Bidder's understanding is correct. |
| 318. | SECTION-VI / PART-A | IV TERMINAL POINTS & EXCLUSIONS | 3 OF 3 | 1.14.00(b) | Instrument air at one point (if required). | NTPC have asked for standalone compressed air system in order to meet the instrument air requirement for FGD.<br>Please clarify whether additional tapping from existing instrument air network shall also be provided for meeting instrument air requirement for FGD.<br>If yes, please furnish the coordinates for the terminal point. | Amendment will be issued in this regard. |

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| 319. | SEC-TION-VI / PART-A | VI FUNC-TIONAL GUARAN-TEES & LIQUIDITY DAMAG-ES | 22 OF 24 | xxiii | Total power consumption at motor input terminal at rated duty of air compressor…….. | Bidder request NTPC to specify the duty factor for considering the auxiliary power consumption for Compressed air system. As the continuous consumption of compressed air will be much less-er than the rated compressor ca-pacity specified by NTPC.<br>In such case, the compressor will go under unload conditions for a considerable time and thus lower power requirements. We request you to specify duty point for air compressors. | Duty point shall be 1.0 . Bidder shall comply with specification requirement. |
| 320. | SEC-TION-VI / PART-A | VI FUNC-TIONAL GUARAN-TEES & LIQUIDITY DAMAG-ES | 19 OF 24 | xv | Compressed air system<br>b.) Following shall be demonstrat-ed at site. | Clause no. b(iii) is missing.<br><br>NTPC is requested to provide the same. | The clause b(iii) does not exist . |

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| 321. | SEC-TION-VI / PART-A | III-A2 AIR CON-DITION-ING, VENTILA-TION SYS-TEM & COM-PRESSED AIR SYS-TEM | 3 OF 4 | 3.00.00 | Compressed air system | Clause no. 3.00.00(e) & 3.00.00(f) are missing.<br><br>NTPC is requested to provide the same. | Clause no. 3.00.00(e) & 3.00.00(f) does not exist. |

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| | | | | | **HOISTS** | | |
| 322. | SEC VI, PART-B | I-M1 | 35 OF 51 | 14.09.00 | Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more.<br>Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc. | Referred clauses are contradictory w.r.t selection of electric or manual hoist. We shall follow clause 10.09.00 of sub-section V/Section VI Part A for selection of electric or manual hoist.<br><br>Kindly confirm. | Bidder shall comply with the specification requirements. |
| 323. | SEC VI, PART-B | I-M6 | 6 OF 73 | 4.3.2 | For the hoists with more than 2.0 tonne lifting capacity or more than 10.0 m lift with the exception of hoists for GTU & bend pulleys motor operated hoist blocks for both long travel & lift shall be provided. | | The referred clauses of technical specifications are very clear and pertains to the requirements of Limestone Handling System & Gypsum Handling System and shall be read independent of the hoist requirement brought out in Subsection I-M1, Section VI, Part-B. |

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| 324. | Section-VI, PART-A | Sub-Section-V | 23 OF 26 | 10.09.00 | Hoists<br>Drive<br>(i) More than 2.0 tonne or more than 10.0 m lift or hoists coming out-side the buildings — Motor travel<br>(ii) Other hoists including the hoists for handling take-up pulley and take-up weight — Manua el & lif | | The referred clauses of technical specifications are very clear and pertains to the requirements of Limestone Handling System & Gypsum Handling System and shall be read independent of the hoist requirement brought out in Sub-section I-M1, Section VI, Part-B. |
| 325. | Section-VI, PART-B | I-M1 | 35 OF 51 | 14.09.00 | Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. | Considering the layout & space constraints, it may not be feasible to provide all electric hoists with maintenance / repair platforms with handrails. Hence maintenance platform shall be provided depending upon feasibility.<br><br>Please Confirm. | Specification requirement is clear in this regard. Bidder shall comply with the specification requirements |

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| 326. | Section-VI, PART-A | Sub-Section-VII | 18 OF 61 | A-10 | MANDATORY SPARES:<br><br>Spares for Electrically operated hoist for FGD WWT system for ZLD (for each type & size) | 7) Mandatory spares of Electric hoists have been mentioned under these two referred clauses/ areas only.<br>Kindly clarify whether Mandatory spares are to be considered for Electric Hoists in area, other than specified in referred clause. In case the same has to be considered, then kindly inform about applicable list of mandatory spares to be followed.<br><br>8) Further, no spares are mentioned for chain pulley blocks. We understand that no spares shall be provided for chain pulley blocks.<br>Please confirm. | Bidder shall comply with the specification requirements given under the clauses referring to the equipment under the sub section VII.<br><br>Confirmed. |
| 327. | Section-VI, PART-A | Sub-Section-VII | 39 OF 61 | K | Mandatory Spares of Limestone & Gypsum Handling:<br>ELECTRIC HOISTS | | |
| **CIVIL** | | | | | | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 328. | VI/A | III-D | 2 of 4 | 1.06.00 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Lay-out plan |
| 329. | VI/B | IV-D | 26 of 69 | 10.00.00 | Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing... | In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same. | FGL is indicated in General Lay-out plan |
| 330. | VI/B | IV-D | 31 of 69 | 14.00.00 | Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. | The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain. | The value of minimum rainfall intensity shall be taken as 75mm/hr.<br>Refer amendment issued separately. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 331. | VI/B | IV-D | 41 of 69 | 21.00.00 | The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. | | |
| 332. | VI/B | IV-D | 24 of 69 | 7.00.00 | In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering... | In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding). | Refer Sl.No.81 |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 333. | VI/B | IV-D | 25 of 69 | 7.00.00 | Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings...<br>All facility buildings shall be provided with 750 mm wide plinth protection all around...<br>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection... | (1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved.<br>(2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted. | Refer Sl.No.82 |
| 334. | VI/B | IV-D | 25 of 69 | 7.00.00 | The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. | | |
| 335. | VI-A | II-A2 | 23-39 of 48 | Annexure-II | BORE LOG | Geotechnical investigation report is not readable. Please provide the report in readable format. | Bidder to refer amendment. |
| 336. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | External surface of the chimney flue liner projecting over the chimney roof shall be wrapped with 2mm thick titanium/ C276 sheet over insulation. | These clauses are contradictory. Bidder understands that if 2mm thick titanium/ C276 sheet wrapping over insulation is provided then no painting is required on | No painting is required on external surface of chimney flue liner projecting above chimney roof. Also refer Amendment in this regard. |

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| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 337. | SEC VI / PART B | IV D | 15 OF 69 | 3.14.09 (iv) | ....., external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. | external surface of the chimney flue liner projecting over the chimney roof. Please confirm. | |
| 338. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. | | |
| 339. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Bidder understands that cladding can be done with explosion bonding or hot rolling or combination of both to achieve the required quality as per ASTM B 898-11. Please confirm. | Bidder shall provide the proposed cladding methods as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 340. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | | |
| 341. | SEC VI / PART B | IV D | 39 OF 69 | 20.00.00 | Electrodes | Please provide the detail/type of electrodes to be used in welding of titanium/C276. | Type of electrode will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval. |
| 342. | SEC VI / PART B | IV D | 39 OF 69 | 20.07.00 | Edge Preparation for Welding | Please provide edge preparation detail for titanium/C276 material. | Edge Preparation detail will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 343. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Please provide the material code to be followed for alloy C-276. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 344. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | | |
| 345. | SEC VI / PART A | V | 8 OF 26 | 5.01.00 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | Kindly furnish the following specifications for chimney liners.<br>1. Permissible tolerances on thickness of clad sheet and base material.<br>2. Permissible tolerances on flatness for clad sheet and base material.<br>3. Specify the quality tests which | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 346. | SEC VI / PART B | I M1 | 6 OF 51 | 3.02.07 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. | will be conducted on the clad sheet for assessing mechanical and chemical properties and on the chimney cans after fabrication.<br>4. Indicate any special requirements applicable for welding and fabrication of chimney at site.<br>5. Indicate any restriction in size of base metal and clad plate to be used for fabrication of flue cans.<br>6. Mention tensile and yield strength of the cladded material to be achieved. | |
| 347. | SEC VI / PART A | I | 10 OF 19 | 4.02.03 | For Chimney, Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height. | Bidder understands that, there is no other prequalification requirements related to fabrication and erection of titanium/ c276 cladded steel flue liner in chimney.<br>Please confirm. | Bidder's understanding is Correct. |
| 348. | SEC VI / PART B | IV D | 2 OF 69 | 2.03.00 | Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height. | | |

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| SL. NO | ENQUIRY SPECIFICATION | | | | SPECIFICATION REQUIREMENT | COMMENTS / QUERIES | NTPC CLARIFICATIONS |
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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 349. | VI / A | V | 8 OF 26 | 5.01.00 | A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor... | The location of new Wet Chimney shall be near to Existing Chimney in the space provided clearing foundation interface. The design of Wet Chimney shall be done considering interface factor of existing chimney as determined by wind tunnel study. However, no design check or validation shall be done for existing chimney/structures/buildings. Kindly confirm. | It is confirmed that no design check or validation shall be done by the bidder for existing chimney(s). |

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| Sl. No. | Vol No | Clause No. | Page No. | Issues | Comments / Clarifications | NTPC reply |
|---|---|---|---|---|---|---|
| 350. | Sec-VI Part-D ,ECC | Clause no. 28.04.00 | Page no. 12 | **Site laboratory for Civil Work** | Bidder through its civil work sub-contractors will set up a tempo-rary field quality Lab to conduct normal civil work tests at site. However, customer to allow bid-der/it's subcontractors to take back those field quality lab equipment after completion of work at site. Please confirm. | We understand that after comple-tion of work at site, contractor may be allowed to take back their lab equipments. |

| SL. | ENQUIRY SPECIFICATION | SPECIFICATION REQUIRE- | COMMENTS / CLARIFICATIONS | NTPC CLARIFICATIONS |
|---|---|---|---|---|

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| NO | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | MENT | | |
|---|---|---|---|---|---|---|---|
| 351. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 04 of 51 | 1.09.00 | The equivalent weighted average of sound level measured at a distance of 1.5 m above floor level in each elevation and one meter horizontally from the base of any equipments furnished and installed under these specifications, expressed in decibel to a reference of 0.0002 microbar, shall not exceed 85 dB(A). | **Deviation:**<br>It is possible to meet guaranteed noise level of 85 dBA for all equipments except for Ball Mill and crushers.<br>The guaranteed values for theses equipments are<br>• Ball Mill : 90 dBA<br>• Crusher : 100 dBA<br><br>Kindly Confirm | Bidder to refer necessary amendment in this regard. |
| 352. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 05 of 51 | 3.01.00 Sl. no: 5 | **Flue Gas Velocity:**<br>Maximum flue gas velocity through the Absorber (m/s)- Not more than 4 m/s at design point | **Deviation:**<br>As per our FGD design practice, maximum gas velocity through the Absorber shall be 4.0-4.5m/s.<br>Kindly confirm. | Bidder shall comply with the specification requirements under the referred clause 3.01.00. |
| 353. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 05 of 51 | 3.01.00 Sl. no: 6 | **Recirculation Slurry pH:**<br>Not Less than 5.5 under all operation conditions | **Deviation:**<br>Based on our FGD design practice, slurry pH in the Absorber is between 5 and 6.5. FGD will be designed for the same.<br>Kindly confirm. | Bidder shall comply with the specification requirements under the referred clause 3.01.00 |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 354. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 06 of 51 | 3.02.04 | The duct from Absorber outlet to bypass duct shall be made of Carbon steel of minimum 7mm thickness with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. | **Clarification:**<br>Treated flue gas after Absorber outlet will be sent to New wet stack. No bypass duct is envisaged.<br>Bidder requested Employer to delete the bypass duct in the scope of bidder.<br>Please confirm | **Bidder to refer necessary amendment in this regard.** |
| 355. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 14 of 51 | 5.01.00<br>Sl. no: iv | The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side. | **Deviation:**<br>Normally in case of recirculation pump area, in case of any pump stoppage the gate needs to quickly close without leakages in the slurry lines. In case of knife gate valves, there may be leakages after few operations due to wearing of components. In such applications, we propose to provide pneumatic operated butterfly valves that are widely provided in FGD plants. | Bidder shall comply with the specification requirements. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 356. | General | | | | | Owner to furnish the following drawings (project wise) which will come as interface for the proposed FGD system:<br>1. ESP Control Room - Plan & Elevation<br>2. Ash Handling System & Buildings - Plan & Elevation<br>3. Pipe Rack around AHS - Plan & Elevation | 1&2. Requested drawings/details will be furnished during the detailed engg. stage with the successful bidder.<br>3. Bidder to refer list of drawings provided at of Sub Section- II- PROJECT INFORMATION (For Various Projects) Section –VI, Part-A for pipe/cable trestle drawings. |
| 357. | General | | | | Barh<br><br>BRBCL Nabinagar | Owner to furnish the Pipe Rack drawings (Plan & Elevation) around existing Chimney which will come as interface for the proposed FGD system for the following projects<br>1. NTPC Barh (3x660 MW)<br>2. NTPC BRBCL (4x250 MW) Nabinagar | Bidder to refer Amended Project Information, being issued separately, as under:<br>1. Table 6 of Sub Section- II-A 11 PROJECT INFORMATION (NABINAGAR TPP) Section –VI Part-A.<br>2.List of drawings provided at Page 30/30 of Sub Section- II- PROJECT INFORMATION (Barh-I 3X660 MW) Section –VI, Part-A. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 358. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 15 of 51 | 5.02.00 | The contractor shall offer and demonstrate mixing arrangement such that n-1 number of agitators are sufficient to avoid the slurry settlement in the absorber tank in case of one agitator under breakdown (n-total no. of working agitators). | **Deviation:**<br>As per our FGD design, under normal FGD operation, the jet Air Sparger (JAS) works to keep the slurry in suspension and no agitators are required to be in operation. The Agitators are required only during FGD stoppage to prevent the deposit settlement. For this purpose, we are offering two numbers of Agitators. However, to meet tender requirement, one spare will be provided as a ware house spare. | **NTPC noted.** |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 359. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 17 of 51 | 5.06.02 | The design of flue gas ducts and inlet and outlet hoods of the FGD as well as guide vanes and baffle plates shall ensure a homogeneous flue gas flow with respect to the distributions of:<br>(i) temperature<br>(ii) velocity<br>(iii) dust content<br>(iv) slurry injection and distribution.<br>The above shall be proven by two phase Computational Fluid Dynamics simulations (liquid and gas). The scope of modelling shall include flue gas path inside the absorber vessel including inlet and outlet duct. Homogeneity shall be ensured, if the deviation from average is less than +10%. Further, in the Absorber outlet hood no internals such as guide vanes and baffle plates shall be allowed. | **Clarification:**<br>Customer's requirement "deviation from average: less than ±10%" is too strict and it is not required for the stable operation at the actual plants based on Bidder' experiences.<br>The deviation from average is generally 15-20% and Bidder designed and delivered FGD plants based on the deviation from the average for approx. ±15%.<br>Bidder requested to change deviation from "±10%" to "±15-20%". | Bidder shall comply with the specification requirements under the referred cl. 5.06.02. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 360. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 17 of 51 | 5.06.06 | **Mist Eliminator:** Three stage chevron type Mist Eliminators (ME) made of Polysulfone or stainless steel shall be provided at the exit of the absorber. | **Clarification:** As per our proven practice, Mist Eliminator will be made of polypropylene (PP) or FRP. Kindly confirm. | Bidder shall comply with the specification requirements under the referred cl. 5.06.06. |
| 361. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 20 of 51 | 5.06.23 | It should be possible to discharge the absorber sump into the auxiliary absorbent tank within 2 hours. | **Clarification:** We propose 8 hours to discharge the slurry from absorber / absorber sump into the emergency drain tank to have optimum design of pumps. Please confirm | Bidder shall comply with the specification requirements under the referred cl. 5.06.23. |
| 362. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 26 of 51 | 7.04.01 Sl no: c | **Vacuum Belt Filters:** Gypsum purity : 90 % ( minimum) | Limestone purity of 89% as CaCO3 is necessary to get 90 wt. % of Gypsum Purity So Gypsum purity will be guaranteed based on 89 % of Limestone purity as CaCO3 (FGD Guarantee point). Please confirm | Bidder shall comply with the specification requirements under the referred cl. 7.04.01 |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 363. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 29 of 51 | 7.08.03 | Agitation shall be provided to prevent settlement of slurry by side entry agitators with emergency flush start system. Sufficient number of agitators shall be provided in the tank by the contractor to prevent the solids from settling down. | As per proven FGD practice, the installation height (shaft installation height) of the agitator will be located above the limestone/Gypsum accumulation level of the tank.<br><br>Bidder will offer agitator without emergency flushing system<br><br>Please confirm. | Bidder shall comply with the specification requirements under the referred cl.no. 7.08.03. |
| 364. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 33 of 51 | 12.02.00 | All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. | **Clarification:**<br><br>As per proven practice, all the pipes handling slurry shall be provided with FRP material.<br><br>Please confirm. | Bidder shall comply with the specification requirements under the referred cl.no. 12.02.00. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 365. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 31 of 51 | 10.01.00 | **Slurry & Process Water Tanks:** Additional Corrosion allowance of 3mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor | **Clarification:** In clause no: 10.01.00, additional corrosion allowance for tank is mentioned as 3 mm whereas in clause no: 13.01.00, it is mentioned as 1.5mm. Kindly confirm the additional corrosion allowance to be considered for the process water tank. | Amendment will be issued in this regard. |
| 366. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 33 of 51 | 13.01.00 | **Process Water Storage Tanks & Pumps:** Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the bidder | | Bidder shall comply with the specification requirements. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 367. | SECTION-VI / Part-B | Project Information | | | **Design Clarified Water Analysis:** | Bidder request Customer to note that use of CW blow down (COC-5.5) for FGD process makeup result in degradation of absorption and/or oxidation performance because the CW blow down inherently contains anticorrosion reagents which will inhibit the performance.<br>Bidder considered clarified water analysis (Design Clarified Water Analysis) for FGD make up without any COC.<br>Please confirm. | Bidder to note that the source of water is as per the tender specifications which is of CW blowdown quality, widely used for FGD process world around. Bidder shall design and supply the system such that degradation of the FGD system will not take place. |
| 368. | SECTION-VI / Part-B | Project Information | | | **Design Clarified Water Analysis:** | Bidder request customer to inform the CW blow (COC-5.5) water temperature which is required for FGD designing.<br>Please furnish. | Please refer specification Cl no-4.02.00 (a), Sub-section -I-M5, Part-B, Section-VI for secondary water inlet temperature. Specification is quite clear in this regard. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 369. | VI-Part-A | IV Functional Guarantees | 18 of 24 | 4.02.00 Sl. No: vi | **Waste Water:** The Contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10m3/hr averaged over a 24 hour period from each unit. | Bidder understands that the waste water requirement is 5 m3/hr for each unit of Nabinagar (4x250MW) project. Total waste water for all 4 units is 20 m3/hr. Kindly confirm. | Kindly refer amendment in this regard. |
| 370. | VI-Part-A | V Salient Design Data & Sizing | 01 of 26 | 1.00.00 | **Salient Design Data & Sizing:** Kudgi (3x800MW), Lara (2x800MW), Gadarwara (2x800MW), Darlipalli-(2x800MW) | In FGD Flue Gas composition, the value of $H_2O$ content specified at design point is very less (i.e. 3.958 % wet) Bidder request customer to check and confirm. | Kindly refer amendment in this regard. |
| 371. | VI-Part-A | V Salient Design Data & Sizing | 03 of 36 & 05 of 36 | 2.00.00 & 3.00.00 | **Salient Design Data & Sizing:** Meja (2x660MW) | **Meja (2x660MW)** The FGD sizing data were furnished for Meja (2x660MW) project in two clauses (2.00.00 & 3.00.00). Kindly confirm FGD sizing data to be considered for design and guarantee. | Kindly refer amendment in this regard. |

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|---|---|---|---|---|---|---|---|
| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 372. | VI-Part-A | V Salient Design Data & Sizing | 07 of 26 | 4.00.00 | **Number of Absorber:** Nabinagar (4x250MW) | **Nabinagar (4x250MW)** Bidder would like to propose common Absorber for 2 units. Therefore 2 Nos of Absorber for all 4 units. Please confirm. | Bidder shall comply with specification requirements. |
| 373. | SECTION-VI / Part-B | SUB-SECTION-I-M1 (FGD) | 08 of 51 | 4.01.01 | **Booster Fan:** Nabinagar (4x250MW) | **Nabinagar (4x250MW)** Bidder would like to propose mono Booster Fan for each unit. Therefore 4 Nos of Booster Fan for all 4 units. Please confirm. | Bidder shall comply with specification requirements. |

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| 374. | VI/B | I-M1 | 4.01.00 | 8 of 51 | **Booster Fan**:<br><br>Additional a pressure loss of 100 mm wcl (excluding margin) shall be built up in booster fan design criteria as mentioned below to take care of pressure loss due to future installation of De-Nox system | We understand from the tender that 44 % margin to be applied over the summation of P1 & P2 where<br><br>P1 is pressure requirement for the FGD system as arrived from the tender sizing conditions for booster fan<br><br>P2 is 100 mm wcl to take care of pressure loss due to future installation of De-Nox system.<br><br>Kindly clarify Bidder understanding. | Bidder's understanding is correct. |

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| 375. | VI/B | I-M1 | 4.04.00 | 11 of 51 | **Booster Fan**:<br><br>Fan rotational speed : 600 rpm (max) | The Booster Fans for these FGD projects are of similar construction to that of axial reaction ID fans and is handling the same volume and flue gas parameter as that of ID fans. In case of Patratu 3x800 MW & Talcher 2x660 MW tenders, NTPC has already issued amendment for ID fan max speed as 750 rpm. Bidder would like to offer FGD Boosters Fans with 750 rpm (max speed). | Bidder shall comply with specification requirements. |

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| 376. | VI/B | I-M1 | 4.04.00 | 11 of 51 | **Booster Fan** :<br><br>Fan casing material thickness : Abrasion and wear resistant, high BHN steel having minimum 8.0 mm thickness or 12 mm mild steel with liner of thickness 10 mm (min.) | The Booster Fans for these FGD projects are of similar construction to that of axial reaction ID fans and is handling the same volume and flue gas parameter as that of ID fans. In case of Patratu 3x800 MW & Talcher 2x660 MW tenders, NTPC has stipulated :<br><br>"ID Fan casing material thickness: Abrasion and wear resistant, high BHN steel having minimum 8.0 mm thickness or 12 mm mild steel with liner of thickness 10 mm (min.) Alternatively, 22 mm thickness casing of mild steel is also acceptable."<br><br>Bidder would like to clarify that offered FGD Booster Fans casing shall be of mild steel without liners and with minimum thickness as per design requirement/ manufacturer's standard. | Bidder to refer necessary amendment in this regard. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 377. | Section-VI, Part A | Sub Section- VII Mandatory Spares | Page 6 of 61 | 1.02.00 Gates in Flue Gas System | 1. Seals [1 set of each type (Set means complete replacement for one gate)]<br><br>&<br><br>4. Seals for guillotine gate (Both port side and bonnet side) (In case Gates are provided) – 1 set for each gate | Port & Bonnet Seals for Guillotine Gate (required as per clause: 4. are already covered in 1. Seals (complete replacement for one gate). Hence, these Port and Bonnet seals are repeating as these items form part of complete set of seals. Please inform whether to consider these seals in Sl. No. 1 alone. | Bidder to refer necessary amendment in this regard. |

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| 378. | Section-VI, Part A | Sub Section- VII Mandatory Spares | Page 6 of 61,<br><br>&<br><br>Page 55 of 61 | 1.02.00 Gates in Flue Gas System<br>&<br>1.26.00 ELECTRICAL → 1.02.00 Electrical Actuators | 1.02.00 → 2. Actuator (1 no. of each type & rating)<br><br>&<br><br>1.26.00 → 1.02.00 Electrical Actuators → 1. Actuators (1 no of each type and rating) | For FGD Gates, we are considering mandatory spare Electrical Actuators under clause 1.02.00 Gates in Flue Gas System → 2. Actuator (1 no. of each type & rating) in Page no: 6 of 61.<br><br>Hence, we are not considering the same electrical actuators under Clause no: 1.26.00 → 1.02.00 Electrical Actuators → 1. Actuators (1 no of each type and rating) in Page no: 55 of 61.<br>Please confirm. | Bidder to refer amendment in this regards. |

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| | SEC/ PART | SUBSEC. | PAGE NO. | CLAUSE NO. | | | |
| 379. | Section-VI, Part B | Sub-Section-I-M1 (FGD) | Page 7 of 51 | 3.03.01 & 3.03.07 | 3.03.01. . . . A gas tight, motor operated Guillotine gate shall be provided by the Contractor in the bypass duct (flue gas duct connecting the existing chimney).<br>&<br>3.03.07. A quick acting biplane damper shall be provided by the Contractor in the bypass duct (flue gas duct connecting the existing chimney) for quick opening to allow bypass to come into operation in case of emergency. The damper shall be capable of quick opening during emergency conditions within a time of 10-20 secs. | When the FGD is in operation, the FGD Bypass Damper will be closed (ensuring 100 % sealing efficiency with seal air fans). However, the FGD Bypass Gate cannot be kept closed as emergency situation may arise suddenly. (The Gate will take not less than 5 minutes considering the Height of the Gate Blade to slide open). **In case the FGD Bypass Gate is also kept closed and emergency situation arises, the purpose of providing the Quick Operating Damper in Bypass duct is vanished and serves no purpose. So, this Gate will be open all the time – whether FGD is in service or FGD not operating.** Hence, only Quick-acting Biplane Damper is required and Guillotine Gate is not required in the bypass duct. | Bidder to reply with specification requirements. |

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| 380. | PART – B | Sub section II- E10 | 11 OF 58 | 4.15.00 | All 415v switchgear panel shall be of single front type. MCC's and DB'S shall be single front\double front construction as per requirement. | Breaker modules will be of Single front and the other modules will be of Double front type construction. Kindly confirm. | Technical Specifications to be complied with. |
| 381. | PART – B | Sub section II- E10 | 12 OF 58 | 5.0.00 | In order to establish the compliance with the requirements of this technical specification, prototype panels shall be made and offered for the employers inspection and approval before the start of manufacturing of panels for this project. | Prototype panel shall consist of one vertical section meeting all the technical requirements indicated by customer. Kindly confirm | Clause is ample clear which says "The exact configuration of such prototype panels shall be finalized during detailed engineering." |

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| 382. | PART – B | Sub section II- E10 | 20 OF 58 | 18.01.00 | All circuit breaker feeders shall be provided with communicable numerical relays complying with IEC- 61850.....Connected to the Switchgear SCADA System | Communication to be given to both DDCMIS & SCADA system. Kindly confirm. | This clause is deleted. Please refer Amendment to Technical Specification (Section VI) |
| 383. | PART – B | Sub section II- E6 | 2 OF 69 | 2.01.05 | The cable vault / cable spreader room space below the HT/LT Switchgear room.....800 mm wide & 2.1m high movement passage . | Since for human movement 2.1m height is envisaged , we are offering vault room with 2.1m height. Kindly confirm. | The same shall be decided during detailed engg.. |

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| 384. | VI-PART-B | VI-D CIVIL WORKS | 24 of 69 | 6.08.00 | Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, ball Mill building shall be through RCC staircase and roof access to all other buildings all shall be through cage ladder as per requirement | It is proposed to provide steel staircases for access to operating floors of all buildings except FGD Control room/MCC building. RCC staircase will be provided for FGD Control room/MCC building.<br><br>Cage ladder may be allowed for access to roofs of all buildings with roof sheeting.<br><br>Kindly accept | Bidder shall comply with technical specification requirement. |
| 385. | VI-PART-B | VI-D CIVIL WORKS | - | - | **Ball Mill Building:** | Type of construction of Ball Mill building is not mentioned in the technical specification.<br><br>Bidder proposes to use structural steel building with roof sheeting and side cladding (sheeting and cladding with permanently colour coated sheeting).<br><br>Kindly confirm. | Type of building structure (Steel/RCC) and cladding system shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints ( if any).<br>However, roof shall be of RCC as per technical specification requirement. |

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| 386. | VI-PART-B | VI-D CIVIL WORKS | - | - | **Gypsum dewatering building:** | Type of construction of Gypsum Dewatering building is not mentioned in the technical specification.<br><br>Bidder proposes to use structural steel building with roof sheeting and side cladding (sheeting and cladding with permanently colour coated sheeting). Floor of Vacuum belt filter will be RCC over metal deck sheeting.<br><br>Kindly confirm. | Bidder shall comply with technical specification requirement. |

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| 387. | VI-PART-B | VI-D CIVIL WORKS | - | - | **Recirculation & Oxidation Blower house:** | Type of construction of the building to house recirculation pumps and oxidation blowers is not mentioned in the technical specification.<br><br>Bidder proposes to use structural steel building with roof sheeting and side cladding (sheeting and cladding with permanently colour coated sheeting).<br><br>Kindly confirm. | Type of building structure (Steel/RCC) and cladding system shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints ( if any).<br>However, roof shall be of RCC as per technical specification requirement. |
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| 388. | SECTION – VI, PART-A | SUB-SECTION-III-A1 FGD | 1.03.00 | 1 of 9 | The contractor's scope shall include,,, common limeston grinding system... | Please confirm if we can have a common limestone, unloading, storage, grinding, slurrification and dosing system for **FGD and ZLD** systems. This would reduce footprint. | Bidder's understanding is correct. |
| 389. | SECTION – VI, PART-A | SUB-SECTION-III-A6 ZLD | 1.01.00 | 1 of 3 | Pre treatment system shall consist of FGD waste water storage tnak (2x50%) to store FGD waste water, | We propose 1x100% tank sized for 30 m3/h inflow (Barh-I) and 20 m3/h inflow (Nabinagar) instead of 2x50% | Stipulations of technical specification is clear. As mentioned in Cl. No. 1.01.00, Sub-section IIIA-6, |

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| | | | | | GGH washing water, etc | tanks. Please confirm.<br>Also please clarify all the waste water sources leading to ZLD, such GGH washing wastes, process wastes, cooling water wastes, if any. | Part-A, Bidder shall provide Pre-treatment system consisting of 2x50% FGD waste water storage tank for storing FGD wastewater, GGH washing water etc.<br>As such, any other waste water as envisaged by Bidder shall also be considered while designing the Waste storage tank. |
| 390. | SECTION – VI, PART-A | SUB-SECTION-III-A6 ZLD | 1.02.00 | 1 of 3 | Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system. | We propose 1x100% Evaporative Concentration System. | Stipulations of Technical specification requirement is clear. Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system. |
| 391. | SECTION – VI, PART-A | SUB-SECTION-III-B ELECTRICAL | 1.02.00 | 1 of 6 | Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 | Please provide this drawing for our reference. Kindly confirm if we can propose a common HT/LT switchgear for FGD & ZLD.<br>Also please confirm if the PLC | Common HT/LT switchgear for FGD & ZLD Can be provided.<br>Regarding integration of ZLD and FGD control in one PLC, confirmation from C&I |

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| | | | | | | based control system for ZLD can be integrated with that of FGD. | may be taken. |
| 392. | SECTION – VI, PART-A | SUB-SECTION-IV Terminal Points & Exclusions | 1.08.00 | 2 of 3 | FGD waste water pipes shall terminate allong with isolation valve at 5 meters near HCSD mixing tank | We presume this is not applicable in Barh & Nabinagar since ZLD is provided. Please clarify. | Bidder's understanding is correct. |
| 393. | SECTION – VI, PART-A | SUB-SECTION-IV Functional Guarantees & LD | 4.02.00 | 18 of 24 | Waste Water: The contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10 m3/h averaged over a 24 hour period for each unit. | Please clarify the exact flow rate to be considered for designing the ZLD. Is it | Bidder to refer necessary amendment in this regard. |
| 394. | SECTION – VI, PART-C | General Technical Requirements | 30.00.00 | 42 of 83 | Noise levels <85 dBA for FGD equipment and <90 dBA for Ball Mills | Please clarify the acceptance of noise levels for ZLD equipment - near field & far field. | Bidder shall comply with the specification requirements. |
| 395. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 2.00.00 | 3 of 32 | Conditions of Service - 'All Design Pressure of all device, piping, and auxiliary facilities...Device and tank maximum allowance: operating pressure x 1.5' and also ' piping and auxiliary | This may not apply for larger "fit for service" equipment like Evaporators and Crystallizers. We will provide our recommendations on design pressures for piping and tanks in our offer based on our | Noted. |

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| | | | | | facilities: 150 lb class flange, STD wall pipe' | proven experience. | |
| 396. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | E 2 | 9 of 32 | Evaporative concentrator shall be designed to start / stop every day | Please clarify why this requirement is made. We presume FGD & ZLD will operate at full capacity continuously. | Bidder shall comply Technical specification requirement. |
| 397. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | E 6 | 9 of 32 | Pressure vessel in evaporative concentration shall be designed as per ASME Sec VIII or equivalent code listed above. | Evaporator is typically not a pressure vessel and not necessarily designed as per ASME Sec VIII. Kindly accept our standard practice. | Technical specification requirement is clear. Any pressure vessel in evaporative concentration shall be designed as per ASME Sec VIII or equivalent code. However, for evaporator, proven design and experience meeting provenness criteria specified in tender is acceptable . |
| 398. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | E 14 | 10 of 32 | Hoists shall be provided for all vessels in evaporative concentration system as per the Manufacturer's proven practice | We will recommend our practtice for handling / maintenance. | Technical specification requirement is clear. However, proven practice of handling and maintenance of OEM is also acceptable which shall be decided during detailed engineering. |

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| 399. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | E 15 | 10 of 32 | Vessel support shall be designed same as materials for vessel. Different material cannot be welded to vessel. | This is not our practice to provide supports of same material as the vessel. We will explain our arrangement of supports in our offer. | Vessel support arrangement as per proven practice of OEM is also acceptable which shall be finalized during detail engineering. |
| 400. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | F 2 | 10 of 32 | Centrifuge to dehydrate solids form evaporative concentration shall be consist of Centrifuge 2x50% | Centrifuge does not 'dehydrate solids' it makes wet cake or solids suitable for landfill. | Bidder's query is not clear. Bidder shall comply Technical specification requirements. |
| 401. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 22 d | 14 of 32 | Size: 1/2%-inchOD minimum | Our minimum is 1/4" OD tube. Kindly accept. | This shall be finalized during detail engineering. |
| 402. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 3.02.01 4) | 15 of 32 | ...the contractor shall provide duplicate pumps (2x100%) or multiple standby pumps for the same service. | Duplicate pumps are not needed for all pumps. We will propose in our offer the applicable connected redundancies and store standbys. | Redundancy with store standby of Pumps as per the proven practice of OEM is also acceptable which shall be decided during detailed engineering. |
| 403. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 3.02.03 2) | 20 of 32 | Slurry tanks shall be provided with screen at the inlet nozzles. | This is not our practice. Screens if required will be provided to protect downstream equipment (such as heat exchangers) as per our proven experience. | Technical specification requirement is clear. However, proven practice of screens for slurry tanks of OEM is also acceptable which shall be decided dur- |

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| | | | | | | | ing detailed engineering. |
| 404. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 3.02.05 6) | 20 of 32 | Additional required equipment for Vapour Compressor : i) Shaft driven lube oil pump | Kindly accept electrically driven lube oil pump due to limitations in design of certain compressor manufacturers | Electrically driven lube oil pumps as per the proven practice of OEM is also acceptable which shall be decided during detailed engineering. |
| 405. | Process Flow Diagram | ZLD | | 3 of 3 | | The scheme shows steam driven crystalizer, whereas write up calls for MVR. Please clarify. | As mentioned in Cl. No. 2.00.00 D, Sub-section I-M7, Part-B, Auxiliary steam if required shall be provided by owner for start-up condition only. For continuous duty, Bidder to design the various systems considering power driven equipment and the same shall be considered in power guarantee. |
| 406. | Part-B | Sec-VI, Sub Sec: I-M7 | 2.00.00 D) | 3 of 32 | Auxiliary steam if required shall be provided by owner for start-up condition only. For continuous duty, Bidder to design the various | We request Customer to provide steam for continuous duty (for Brine concentrator & Crystallizer) to optimize power consumption. Kindly con- | Technical specification requirement is clear. Auxiliary steam if required shall be provided by owner for start-up condition only. |

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| | | | | | systems considering power driven equipment and the same shall be considered in power guarantee. | firm acceptance. | For continuous duty, Bidder to design the various systems considering power driven equipment and the same shall be considered in power guarantee. |
| 407. | Part-B | Sec-VI, Sub Sec: I-M7 | 3.02.06 -11 | 30 of 32 | Mechanical Vapour Compressor<br>One (1), 100% duty, centrifugal compressor shall be provided. Compressor shall have 2507 casing, 2507 impeller . Inlet guide vanes or an outlet damper valve shall be provided for flow control. Oil cooler, filter and vibration monitoring shall be included as required. | We recommend steam driven for the application if steam can be made available. Request Customer to provide steam for continuous duty of Crystallizer. Kindly confirm acceptance. | Technical specification requirement is clear. Auxiliary steam if required shall be provided by owner for start-up condition only.<br>For continuous duty, Bidder to design the various systems considering power driven equipment and the same shall be considered in power guarantee. |
| 408. | Part-B | Sec-VI, Sub Sec: I-M7 | 3.01.00<br><br>3.01.00 E) | 4 of 32<br><br>9 of 32 | Evaporative concentration system consisting of 1x100% or 2x50% Evaporator/Brine concentrator train(s) to be provided to accept feed from Pre- | The clauses are contradictory. We presume that both the options i.e 1x100% and 2x50% are acceptable. Kinldy confirm. | Evaporative concentration system consisting of 1x100% or 2x50% Evaporator/Brine concentrator train(s) shall be be provided. |

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| | | | | | treatment<br><br>Contractor shall provide two independent trains (2x50%) to maintain for redundancy of critical operations; | | |

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| 409. | VI Part D | ECC | 11/53 | 27.02.00 | Water<br>Contractor shall make all arrangements himself for the supply of construction water as well as portable water for labour and other personnel at worksites/colony. **However drawl of construction/portable water from bore well shall be permitted if found suitable.** | Owner requested that Construction & domestic water shall be provided at a single point free of charge. All arrangements for further distribution beyond this point have to be made by the Contractor. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 410. | VI Part A | III D | 2/4 | 2.00.00 (1) | Providing drinking and service water for bidder labour, staff and other personnel..... | | |
| 411. | VI Part A | III D | 2/4 | 2.00.00 (4) | Providing all arrangement for the supply of construction water including bore wells, water tankers etc. | | |
| | | | | | | | |
| 412. | VI Part A | III D | 2/4 | 2.00.00 (5) | Providing Temporary construction office, construction stores open/covered..... | As per the bid specifications we understand that the owner shall provide land, free from all encumbrances, free of charge for construction of site office.<br><br>Owner to confirm the availability of same. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 413. | VI Part D | ECC | 12/53 | 28.01.00 | Contractors site office establishment<br>The contractor shall establish a site office and keep posted an authorized representative..... And the employer | | |
| 414. | VI Part A | III D | 2/4 | 2.00.00 (5) | Providing Temporary construction office, construction stores open/covered..... | As per the bid specifications we understand that the owner shall provide land, free from all en- | Bidder shall comply with technical specification requirement. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 415. | VI Part D | ECC | 16/53 | 35.01.00 | All the equipment's furnished under the contract and arriving at site shall be promptly received, unloaded and transported and stored in the storage spaces by the contractor. | cumbrances, free of charge for construction of open yard, closed storage sheds.<br><br>Owner to confirm the availability of same. | |
| 416. | VI Part A | III D | 2/4 | 2.00.00 (2) | Developing temporary staff colony& labour colony……. | As per the bid specifications we understand that the owner shall provide land, free from all encumbrances, free of charge for construction labour colony and other site infrastructure.<br><br>Owner to confirm the availability of same. | Bidder shall comply with technical specification requirement. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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| 417. | /Section-VI/Part-A/Subsection-I Intent of Specification/4.05.02 | | Further, in such a case, such qualified equipment manufacturers should have directly or indirectly through its Holding company/Sbusidiary company, at least 26% equity participation in the Indian Joint Venture Company/Subsidiary Company, which shall be maintained for a lock -in period of seven (7) years from the date of incorporation of such JV/subsidiary or up to the end of defect liability period of the contract whichever is later. | It is applicable to critical equipment or all the equipment and materials? | Bidder to refer clarifications being issued separately. |

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| 418. | Amendement No.1 to Technical Specification/Section-VI/Part-A/Subsection-I Intent of Specification/1.01.01 | 2/19 | TECHNICAL SPECIFICATION (SECTION VI PART A)1.01.01 2 OF 19 (New Clause added) Government of India has launched “Make in India” initiative to transform India into a global design and manufacturing hub. Accordingly , to promote manufacturing within India, the import content in Flue Gas Desulphurisation (FGD) System package has been restricted to 30% of the total Supply value quoted by Bidder in Price Schedule-11plus Schedule-2 . . Bidder shall ensure that it does not import more than 30% of its Supplies and shall manufacture/source equipmenUco mponents from within India to meet the aforesaid requirement. | Considering Schedule - 1 and Schedule - 2, the two clarifications made by the Employer are ambiguous. Please further clarify:<br>1. whether the 30% restriction applies only to the FGD system or also to the stack system and the ZLD system.<br>2. what the denominator is in the calculation of the 30% restriction. Is it the total of the prices in Schedule - 1 and Schedule - 2, or the sum of the prices for the FGD system in Schedule - 1 and Schedule - 2? or anything else?<br>3. It is suggested that the ZLD system should not be subject to the 30% restriction. (The system has to be imported because no such technology is available locally.)<br>4,Whether the equipment and materials produced by a foreign company in a sole proprietorship or joint venture in India belong to "made in India"? | Bidder to refer clarifications being issued separately. |

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| 419. | Section VI/Part A/Sub Section III Scope of Supply and Services | | | 1,Please clarify whether the spare parts for the wet stack, stack condensate system, stack flow simulation, stack corrosion protection, stack lift, etc. are in the scope of supply of the Bidder?<br>2, Who is going to provide the weighing wridge for road trucks / Tipplers?<br>3, Who is going to provide the front end loader/ pay loader? | |
| 420. | Section VI/Part A/SubSectionA1 FGD/6.01.00 | 5/9 | The employer shall provide a common auxiliary absorbent tank, common for all the unites, of sufficient capacity for storage of absorber slurry of one unit. | Please clarify who shall supply the auxiliary absorbent tank, the Employer or the Contractor? Please advise us of the dimensions of the tank if it is provided by the Employers. Who is responsible for the corrosion protection of the tank? | The Contractor shall provide an auxiliary absorbent tank. Bidder to refer necessary amendment in this regard. |
| 421. | Section VI/Part B/SubSection-I-MI FGD/6.01.00/7.08.01 | | The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absober tank at its maximum level equipped with ..... | | Specification requirement is clear in this regard. |

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| 422. | Section VI/Part B/SubSection-I-MI FGD/6.01.00/7.04.03 | | Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Employer. | Please advise us of the location for gypsum storage. | Bidder to identify the suitable location for Gypsum storage based on the tender drawings provided. |

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| 423. | Section VI/Part E/ Electrical single line diagram for FGD Package/Drg No.0011-109-POE-J-001 / A-E | 53/53 | | Query 1: About the drawing 0011-109-POE-J-001 / A-E:<br>① Which part in the single-line diagram is for the existing switch board segments or the additional HV and LV switch board segments? Please clarify the scope of work.<br>② Please advise us of the current rating and breaking capacity of the 11kV circuit breakers for the FGD system and clarify whether the circuit breakers are within the scope of work. Please also advise us of the cable type and channel length for the connection of the two segments and clarify whether the supply and reconstruction of the cable is within the scope of work.<br>③ Regarding Note 11, please advise us of the capacity of the coal handling / ash handling segment and the specific type and model of the existing 11/3.3kV transformer for the consideration of replacement with a DD type transformer. Please advise us of the existing wiring of the transformer and clarify whether the switchgear and cable are within the scope of supply Please advise us of the HV side cable length from the transformer to the main power building and clarify whether the existing cable can be re-used.<br>④ Is the 415V segment for the FGD system for one unit or two units? Is the diesel generator necessary? Is it acceptable for the Bidder to supply an emergency power supply from the main power building instead of the diesel generator?<br>⑤ Is it acceptable for the two FGD systems to share one DC system and one UPS system? The DC system consists of two sets of lead-acid valve-controlled maintenance-free batteries, two high-frequency switching chargers and two DC feeder panels.<br>Query 2: Please advise us of the interfaces between the main power building and the cables and Lighting protection and grounding systems for the FGD system<br>Query 3: Are there any special requirements of the motors, switchgears, primary elements, secondary elements, etc. for environment, such as temperature and humidity? | Querry 1:<br>1) Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI).<br>2) Please refer Techincal Specification Section VI/Part-B/Subsection -II-E1 & E9.<br>3) Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI).<br>4) Bidders shall create suitable number of 415V LT Systems for feeding FGD loads as per requirement. Scheme shown in SLD is typical for the entire FGD plant. Bidder to refer Note-8 of Revised SLD being issued with AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI) regarding applicability of DG set.<br>5) Common DC system for entire FGD Plant is acceptable. However the DC system shall be as per requirments of Techincal Specification Section VI/Part-B/Subsection -II-E1, E16 and E17.<br><br>Querry 2:<br><br>Querry 3: Please refer Techincal Specification Section VI/Part-B/Subsection -II-E1. |

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| 424. | Section VI/Part B/SubSection-III-C&I | | | Please advise us of the respective numbers of the operator stations and the engineer stations (to provide according to the configuration as shown in 0000-151-POI-A-013?).<br><br>The Technical Specification does not mention the CCTV system. Please clarify whether the CCTV system for the FGD system is within the scope of supply.<br><br>Please clarify whether the environmental acceptance of the CEMS system is within the scope of work. | i) Bidder to refer clause 6.01.00, PART-A, Sub Section-IIIC, where in it is mentioned that Operator Work Station (OWS) shall be supplied on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). However, bidder to consider minimum quantity of OWS and OWS cum EWS as follows:<br>a) OWS (placed in FGD control room)-(N+1) where N is the total number of generating units per project under this package.<br>b) OWS cum EWS (placed in FGD control room)-ONE (1)<br>c) OWS (placed in central control room of each generating unit)-TWO (2).<br>Bidder to refer amendment in this regard.<br><br>ii) CCTV system for FGD is not in bidder's scope of supply. |

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| | | | | | iii) Bidder's query is not clear. Bidder shall comply with the specification requirement. |
| 425. | Section VI/Part B/SubSection-IV-CIVIL | | | Please provide the geotechnical investigation report and the trial pile report for the main power building. | Bidder to refer Project information chapter. Bidder to refer necessary amendment in this regard. |
| 426. | Section VI/Part A/Sub Section III Scope of Supply and Services | | | Please confirm the scope of supply for water supply and drainage? Is sanitary ware not within the scope of supply? | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 427. | Part-B-Sec-MI | 5.01.00, A, (iv) | 5 of 51 | Maximum flue gas velocity through the absorber (m/s) : Not more than 4.0m/s at design point conditions | Maximum flue gas velocity through the absorber (m/s) : Not more than 4.0m/s at guarantee point conditions | Flue gas velocity through the absorber is important design factor for FGD. Fast velocity increases mist carry over and low velocity decrease $SO_2$ removal efficiency. Considering both guarantee items ab- | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 5.01.00.. |

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| | | | | | | sorber diameter is designed to have proper velocity. | |
| 428. | Part-B-Sec-MI | 5.01.00, A, (iv) | 14 of 51 | The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side | The slurry recirculation pumps shall have motor driven butterfly valve at pump suction and discharge side | Space for installation of knife gate valve is larger because whole disc will come out when valve opens. Butterfly valve needs smaller installation space and is economical and we have proven experiences. | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 5.01.00.. |
| 429. | Part-B-Sec-MI | 5.01.00, A, (iii) | 14 of 51 | The slurry recirculation pumps shall have a minimum margin of 10% of flow and 10% on friction head, over the actual requirement for meeting the guarantee and design point conditions. | The slurry recirculation pumps shall have a minimum margin of 10% of flow and 1~2% head, over the actual requirement for meeting the guarantee and design point conditions. | If pressure has 10% margin, it is difficult to control flow rate at spray nozzles for suitable droplet size related to $SO_2$ removal efficiency due to required operation pressure at spray nozzle. | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 5.01.00.. |
| 430. | Part-B-Sec-MI | 5.01.00, A, (v) | 14 of 51 | Sufficient redundancy, as per the proven practice of the bidder, shall be provided in | Sufficient redundancy, as per the proven practice of the bidder, shall be provided in the spray nozzles. | Quantity of nozzles at each level is designed according to the nozzle arrangement. Recirculated | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 5.01.00.. |

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| | | | | the spray nozzles. Minimum 10% spare nozzles shall be provided at each level. | Minimum 10% spare nozzles shall be provided as spares | slurry shall be sprayed through all nozzles to cover cross section and flue gas contacts with slurry. 10% spare nozzles will be provided as spares for maintenance. | |
| 431. | Part-B-Sec-MI | 5.06.06 | 18 of 51 | Adequate number of viewing ports with flushing devices connected to automatically operating washing system shall be delivered at following locations | Adequate number of viewing ports with flushing devices connected to manually operating washing system shall be delivered at following locations | Operators check inside of absorber occasionally therefore manual flushing devices are provided to reduce cost. | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 5.06.06. |
| 432. | Part-B-Sec-MI | 6.06.01 | 24of 51 | For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower. | For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed 25~30% | Our design guide & reference for solid concentration of limestone slurry: 25~30wt% | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 6.06.01. |
| 433. | Part-B-Sec-MI | 6.07.01, (v) | 24 of 51 | Solid concentration : Max. 20% by weight | Solid concentration : Max. 35% by weight or actual | Our design guide & reference for solid concentra- | Bidder shall comply with the Technical Specification requirements |

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| | | | | or actual as per suppliers practice, whichever is minimum | as per suppliers practice | tion of limestone slurry: 25~30wt% | under the referred cl.no. 6.07.01 |
| 434. | Part-B-Sec-MI | 7.04.01, (a) | 25,26 of 51 | Each vacuum belt filter shall be sized to meet the following requirements, all occurring together with and inlet solid concentration of not more than 45% or outlet of hydrocyclones whichever is minimum : 110% of gypsum produced by absorber at design point | Each vacuum belt filter shall be sized to meet the following requirements, all occurring together with : 110% of gypsum produced by absorber at design point | Our design guide & reference for solid concentration of gypsum slurry : Around 50wt% | Will be discussed during detail engg.. |
| 435. | Part-B-Sec-MI | 12.03.00 | 33 of 51 | The isolation valves provided in all the slurry lines shall be of knife gate type / butterfly type unless specifically mentioned. Motorized actuators shall be provided for | The isolationvalves provided in all the slurry lines shall be of knife gate type / butterfly type unless specifically mentioned. Motorized / Pneumatic actuators shall be provided for valves requiring | Both type of actuators can be applied for slurry lines and considering the cost, pneumatic type is economical. | Specification requirement is clear. Bidder to also refer tender schemes. |

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| | | | | valves requiring frequent operation as indicated in the relevant scheme. | frequent operation as indicated in the relevant scheme. | | |
| 436. | Part-B-Sec-MI | 1.09.00 | 4 of 51 | Noise level<br>-shall not exceed 85dB(A) | Noise level<br>a) Wet Mill only<br><105 dB(A)<br>b) Crusher only<br>< 102 dB(A) | | Refer necessary amendment in this regard. |
| 437. | Part-B-Sec-MI | 5.06.06 | 17 of 51 | Three stage chevron type Mist Eliminators (ME) made of polysulfone or<br>stainless steel shall be provided at the exit of the absorber. | Three stage chevron type Mist Eliminators (ME) made of polysulfone, stainless steel or PP shall be provided at the exit of the absorber. | | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 5.06.06 . |
| 438. | Part-B-Sec-MI | 5.06.10 | 19 of 51 | The raw gas inlet duct of the absorber shall be equipped with a flushing<br>device of the side walls and the ground, which shall operate continuously | NA | It is unnecessary according to our references. | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 5.06.10. |

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| | | | | as well as intermittently. | | | |
| 439. | Part-B-Sec-MI | 6.06.04 | 24 of 51 | The slurry preparation tank shall be CS construction with replaceable chlorobutyl /bromobutyl rubber lining of minimum 5 mm thickness. | The slurry preparation tank shall be CS construction with replaceable chlorobutyl /bromobutyl rubber lining of minimum 5 mm thickness or KS's flake glass lining. | We have proven experience. | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 6.06.04. |
| 440. | Part-B-Sec-MI | 6.06.03 | 24 of 51 | The limestone slurry tanks shall be installed indoor beneath the hydrocyclone station. | The limestone slurry tanks shall be installed outdoor. | Pipes from hydrocyclone to limestone slurry storage tank will be design to have gravity flow. | NTPC noted. Bidder to refer necessary amendment in this regard. |
| 441. | Part-B-Sec-MI | 6.07.03 | 24 of 51 | The slurry pipes shall be lined with replaceable natural rubber lining of 10 mm thickness. Additional thickness of 2 mm rubber ling shall be provided at bends. | The slurry pipes shall be lined with replaceable natural rubber lining of 5 mm thickness. Ceramic lined shall be provided at bends. | | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 6.07.03. |

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| 442. | Part-B-Sec-MI | 7.08.04 | 29 of 51 | The auxiliary absorbent tank shall be made of minimum 7 mm thick carbon steel with 4 mm thick rubber lining of best quality bromine butyl rubber~ | The auxiliary absorbent tank shall be made of minimum 7 mm thick carbon steel with 4 mm thick rubber lining of best quality bromine butyl rubber or flake glass lining ~ | | Bidder shall comply with the Technical Specification requirements under the referred cl.no. 7.08.04. |
| 443. | | | | Electrical Room | We would like to apply 3 electric room as below to reduce cable size and construction BOM;<br>1) FGD Electric Room 2) L/S Preparation Electric Room<br>3) G/S Dewatering Electric Room | | This will be discussed during detailed Engineering. |

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| 444. | Section-VI/Part-B/ Sub-section- I -M1 | 3.02.04 | Page 6 of 51 | The duct to Absorber inlet shall be made of Carbon steel of minimum 7mm thickness. The duct to Absorb-er inlet shall be made of Carbon steel of minimum 7mm thickness. The duct **from Absorber outlet to bypass duct** shall be made of Carbon steel of minimum 7mm thickness with 2 mm (minimum) thickness lin-ing / cladding / wall paper of Alloy C276 / Alloy 59 or better material. | In Part E, 0011-109-POM-A-001 (a) and 0011-109-POM-A-001 drawings, the absorber clean gas flue duct is not connected to the bypass flue duct, please clarity whether the bypass flue duct should be connect to new chimney? | Bypass duct is already connected to the existing chimney. Refer necessary amendment in this re-gard. |

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| 445. | Section-VI/Part-B/ Sub-section- I -M1 | 4.01.01<br><br>4.01.02 | Page 8 of 51<br><br>Page 9 of 51 | (i) Flue Gas Flow through fan:<br>920 m3/sec for all 800 MWunits<br>724 m3/sec for 660 MW units of Mouda, Tanda , Nabinagar STPP & Barh-I<br>802 m3/sec for 660 MW units of Meja<br>893 m3/sec for 660 MW units of Solapur<br>297 m3/sec for 250 MW units of Nabinagar TPP<br><br>(ii) Flue gas flow through each fan<br>727 m3/sec for all 800 MW units<br>600 m3/sec for 660 MW units of Mouda, Tanda , Nabinagar & Barh-I<br>645 m3/sec for 660 MW units of Meja<br>678 m3/sec for 660 MW units of Solapur<br>237 m3/sec for 250 MW units of Nabinagar TPP<br><br>(iii) Margin over pressure require-ment<br>44% over the calculated value<br>(IV)**Note to 4.02.01 & 4.02.02:**<br>Booster fan shall have a minimum stall margin of 10%<br>over the Design duty points. | (i) Please clarify the flue gas flow through fan in this clause is at which condition(TB point) ?<br>(ii) Please clarify the flue gas flow through fan in this clause is at which condition(BMCR point) ?<br>(iii) Could we choose the marign of the booster fan pressure as 20% over the calculated value.<br>(IV) Please clarify whether we sized the flow of each booster fan as 50% of the total gas flue flow of the design point FGD and con-sider 10% margin as clause (IV) or sized the flow of each booster fan as clause (I) and (II). | Bidder shall size the Booster Fans as per the criteria specified in the Technical Specification. |

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| 446. | Section-VI/Part-B/ Sub-section- I -M1 | 3.01.00<br><br>16.01.03 | Page 5 of 51<br><br>Page 39 of 51 | Design internal pressure at 67% yield strength (mm wc) :<br>+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher<br><br>All flue gas ducts shall also be de-signed for ± 660 mm w.g., or maxi-mum<br>conceivable pressure of the relevant fans, whichever is higher at 67% of yield strength of material | Please clarify which clause should we obey | Refer necessary amendment in this regard. |
| 447. | | | | | Kudgi STPP,Stage-I（3X800MW）项目，图纸9573-999-POC-F-001显示，在烟囱的北侧场地中布置有“ESP&VFD，XFMR”，请澄清如下：（1）请提供ESP&VFD的 | Bidder to refer the revised GLP in issued amendments. |

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| | | | | | 图纸（包括基础，结构和建筑图纸）；<br>(2) ESP&VFD 是否已建设好？因该区域便于布置FGD系统，所以ESP&VFD是否可以移至其他区域？<br>For project Kudgi STTP ,the drawing 9573-999-POC-F-001 shows that there is a ESP&VFD con-trol room at the north of the chimeny .<br>Please clarify that：<br>(1) Please provied the ESP&VFD draw-ings(including Profile Drawing, base drawing , Structure drawing )<br>（2） whether the ESP&VFD control room has been built up ,if not ,could the owner move | Requested documents will be dis-cussed with the successful bidder during the detail engg. stage. |

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| | | | | | the ESP&VFD control room to another region ,because the region is easy to arrange FGD system . | |
| 448. | SECTION – VI/PART-A/SUB SECTION-III-A1 | 5.05.00 | Page 5 of 9 | The gypsum slurry from each Absorber shall be fed to a common Primary hydro-cyclone feed tank (sized for minimum 1 hr storage ca- | 请明确我方是否可以按照1台机的1小时的石膏浆液存储量设置石膏浆 | The common Primary hydro-cyclone feed tank shall be sized for minimum 1 hr storage capacity considering all the units oper- |

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| | | | | pacity). | 液缓冲箱<br>Please clarify whether provide a common Primary hydro-cyclone feed tank which sized for minimum 1 hr storage capacity for 1 unit | ating at Design point. |
| 449. | SECTION – VI/PART-A/SUB SECTION-III-A2<br><br>Section-VI/Part-B/ Sub-section- I -M1 | 6.02.00<br><br>7.08.02 | Page 5 of 9<br><br>PAGE 29 OF 51 | The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.).<br><br>The contractor shall provide 2 x100% pump to pump back the slurry from the sump<br>back to the absorber in a maximum time of 8 hours. | Please clarify how many slurry pumps for pumping the slurry back to the absorber should we provide for one FGD system | The contractor shall provide 2 x100% pump to pump back the slurry from the sump<br>back to the absorber in a maximum time of 8 hours.<br><br>Refer necessary amendment in this regard. |
| 450. | SECTION – VI/PART-A/SUB-SECTION-IV | 1.04.00<br>1.05.00<br>1.06.00 | PAGE 1 OF 3 | | Please clarify how far away form the DM normal make up pump discharge,condensate transfer pump discharge,CW pump house,potable water pump discharge,HVAC | Requirement of Technical Specification are clear. Also refer GLP for the project. |

| S.N | Sec-tion/Part/Chapter | Clause No. | Page No. | Statement of subject | Clarification | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|
| | | | | | make up pump discharge .etc from the chimeny. | |
| 451. | Section-VI/PART-B SUB-SECTION-I-M1 | 7.08.01 | PAGE 29 OF 51 | The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump It should be possible to discharge the each absorber into the emergency drain tank within 2 hours. | Please clarify whether the emergency drain tank and the auxiliary tank be the same tank with different name. And discharge the absorber slurry to the auxiliary tank in 2 hours is too short for the FGD system , we advice that the gypsum sized to discharge the absorber slurry to the auxiliary tank in 8 hours | Auxiliary absorbent tank & emergency drain tank referred in the clause are same. |
| 452. | SECTION – VI/PART-A/SUB SECTION-III-A1<br><br>Section-VI/Part-B/ Sub-section- I -M1 | 7.03.00<br><br>13.03.04 | Page 6 of 9<br><br>Page 34 of 51 | One (1) clarified water Storage tanks (each tank catering to the clarified water requirement for all the units) along with two numbers of 2x100 % clarified Booster water pumps (Each pump catering to the clarified water requirements for all the units) from terminal point. | Please clarify how many clarified water Storage tank should we provide for one FGD system | Bidder shall provide Two (2) clarified water Storage tanks along with two numbers of 2x100 % clarified Booster water pumps.<br><br>Bidder to refer necessary amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
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| | | | | Two (2) clarified water Storage tanks along with two numbers of 2x100 % clarified Booster water pumps from terminal point shall be provided by the Contractor. The two tanks shall be interconnected with an isolation valve. | | |
| 453. | | | | | Please provide the tem-perature of the DM water and process water for the FGD system. | Please refer specification Cl no-4.02.00 (a), Sub-section -I-M5, Part-B, Section-VI for secondary water inlet temperature. Specifi-cation is quite clear in this regard. |
| 454. | | | | | Please clarify whether the PID in the tender specifi-cation can be optimized according to our technol-ogy. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 455. | | | | | For the project Kudgi STTP ,the drawing9573-999-POM-A-001 shows that there is a line(Marked as:Member for supporting cable trays at EL(+)3.4 | The line marked in the drawing is fire fighting line routing inside trench below paving level. Bidder to take care of this pipe while fi-nalisation of FGD system |

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| | | | | | (typ)) between ID fan out-let flue gas duct and ESP&VFD.<br>Please check：Whether the line can be moved. | |
| 456. | | | | | For the project Gad-arwara STPP,Stage-I（2X800MW）,the draw-ing 9572-999-POC-F-001 shows that A pipe rack connects two electrostatic precipitator between stack and FGD area,but the drawing 9572-999-POM-A-001 shows that the pipe rack is set be-tween FGD and road, and the ESP control room is placed in different loca-tions,please check the pipe rack and ESP control room position. | Bidder to refer Amended GLP being issued separately. |

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| 457. | | | | | Please clarify the elevation of the AUX BOILER area and the Chimney area in SOLAPUR project. | Bidder to refer Topographical Survey drawing. |
| 458. | | | | | Please clarify the elevation range of the pipe supporting trestle between the FGD area and the Chimney area in MOUDA project. | Bidder to refer drawings at S.No 6 and 7 in Page no 40/40 Sub Section-II-A5 PROJECT INFORMATION (MOUDA-II 2x660MW) Section –VI, Part-A for pipe/cable trestle drawings. |

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| 459. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.02.01 | 12 of 19 | Bidder/ Sub Vendor should have manufactured and supplied at least a total of four hundred & fifty (450) nos. draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels ~ | Bidder understands that Total Quantity of Panels will be decided during detail design stage based on FGD Bidder's design such as Electrical Load list and Single line diagram within performance guarantee and contract requirements for spare feeders per each contracted Project. (It will be changed due to Bidder's system design and contracted project | This is proveness criteria for Vendor selection for LT Switchgear to be supplied under this package and refers to the past experience. |

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| | | | | | Quantity).<br>Please confirm. | |
| 460. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.02.01 | 12 of 19 | Bidder/ Sub Vendor should have manufactured and supplied at least one hundred & fifty (150) nos. of Air Circuit Breakers ~ | Same with above. | Same as above. |
| 461. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.02.02 | 12 of 19 | Bidder/Sub-vendor should have manufactured and supplied at least a total of two hundred & twenty five (225) nos. draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels ~ | Same with above. | Same as above. |
| 462. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.02.02 | 12 of 19 | Bidder/Sub-vendor should have manufactured and supplied at least seventy five (75) nos. of draw out type Air Circuit Breaker panels ~ | Same with above. | Same as above. |
| 463. | Section-VI (TS) | 4.03.03.01 | 13 of 19 | The Bidder/ Sub Vendor should have manufac- | Same with above. | Same as above. |

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| | Part-A Sub-section-I Intent of Specification | | | tured and supplied on an average one hundred (100) numbers of 11 kV and /or 6.6kV Switchgear panels ~ | | |
| 464. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.03.02 | 13 of 19 | The Bidder/ Sub Vendor should have designed, manufactured and supplied at least one hundred (100) numbers of 11 kV and /or 6.6kV Switchgear panels | Same with above. | Same as above. |
| 465. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.03.03 | 13 of 19 | The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers ~ | Same with above. | Same as above. |
| 466. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.03.04 | 13 of 19 | The Bidder/ Sub Vendor should have manufactured and supplied on an average one hundred (100) numbers of 11 kV and /or 6.6kV Switchgear panels ~ | Same with above. | Same as above. |
| 467. | Section-VI | 4.03.03.05 | 13 of 19 | The Bidder/ Sub Vendor | Same with above. | Same as above. |

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| | (TS) Part-A Sub-section-I Intent of Specification | | | should have manufactured and supplied at least one hundred (100) numbers of 11 kV and /or 6.6kV Switchgear panels ~ | | |
| 468. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.03.06 | 14 of 19 | The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers ~ | Same with above. | Same as above. |
| 469. | Section-VI (TS) Part-A Sub-section-I Intent of Specification | 4.03.04.01 | 14 of 19 | Numerical Relays shall be offered from a Manufacturer who has manufactured and supplied and successfully configured at least 100 No's of Numerical Relays with IEC 61850 ~ | Bidder understands that Total Quantity of Numerical Relays will be decided detail design stage based on FGD Bidder's design such as Electrical Load list and Single line diagram within performance guarantee and contract requirements for Numerical Relays per each contracted Project. (It will be changed due to Bidder's system design and contracted project Quantity). Please confirm. | Same as above. |
| 470. | Section-VI | 4.03.05.01 | 14 of 19 | The Bidder/ Sub-Vendor | Bidder understands that Total | Bidder's understanding is not cor- |

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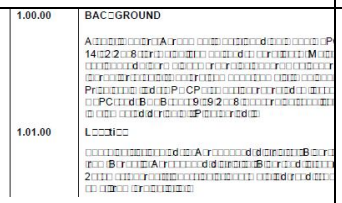
| | (TS) Part-A Sub-section-I Intent of Specification | | | should have manufactured & supplied at least two numbers (one each at two different installations) of 16 MVA, 11KV or higher rating oil filled Transformers ~ | Quantity and rating of Transformers will be decided detail design stage based on FGD Bidder's design such as Electrical Load list and Single line diagram within performance guarantee per each contracted Project. (It will be changed due to Bidder's system design and contracted project Quantity).<br>Please confirm. | rect.<br>This is proveness criteria for Vendor selection for transformers to be sup-plied under this package and refers to the past experience. |
| 471. | Section-VI (TS) Part-A Sub-section-II-A8 Project Information-Nabinagar-I 3x660MW | - | - |  | All letters in NABINAGAR Project Information is not able to be understood. Please provide this tender again. | Bidder may collect legible soft copy from the contact for communication as published in the subject NIT. |
| 472. | Section-VI (TS) Part-A Sub-Section-III-A1 | 25.00.01 | 9 of 9 | Wet stack of 150 metre height shall be provided with a stack condensate collection system to avoid the carryover of | Bidder understands that the end point of Stack is 150m far from ground. Please clarify the meaning of 150 metre height. | Bidder's understanding is correct. |

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| | Flue Gas De-sulphurisation System | | | the condensate/acidic dews/water drop-lets/Gypsum coming out of the stack. | | |
| 473. | Section-VI (TS) Part-A Sub-Section-III-A1 Flue Gas De-sulphurisation System | 25.00.05 | 9 of 9 | A common Nickel based alloy material stor-age/neutralizing tank for the both the units of storage capacity of 12 hrs of stack condensate of both the stack shall be provided. Storage tank/neutralization tank shall be complete with dosing, mixing and prep-aration system. After neutralization of the stack condensate collec-tion, same shall be pumped to common drain system. Contractor shall provide 2 X100% pumps, complete with valves, piping fittings, level control/monitoring etc. | Bidder would like to apply exter-nal piping from wet stack to ab-sorber reaction tank in order to drain the condensate without storage/neutralizing tank. Bidder have experience applying to pre-vious project.<br><br>Please confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | | | | Alternatively, bidder may propose its proven system for disposal of the condensate system in its bid for Employer's consideration. All the material in contact with the condensate shall be of suitable material for the operating duty. | | |
| 474. | Section-VI (TS) Part-A Sub-Section-III-A1 Flue Gas Desulphurisation System | 25.00.06 | 9 of 9 | Stack outlet liquid collector shall be designed in such a way so that the liquid condensate film near the exit of the stack is collected instead of carrying with the exit gas. Bidders shall provide all these details in its bid. | Liquid collector design only can be finalized after carry out the physical model by design agency. Please Clarify. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 475. | Section-VI (TS) Part-A Sub-section-III-A2 Air Conditioning, Ventila- | 1.00.00(g)<br>2.00.00(g) | 1 of 4<br>2 of 4 | Air Conditioning System: Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning sys- | Please clarify whether common microprocessor/PLC/GIU based control system for control and monitoring can be provided for both air conditioning and ventilation system. | Common microprocessor/PLC/GIU based control system for control and monitoring for both air conditioning and ventilation system can be provided.<br><br>Control and monitoring of air conditioning and ventilation system from FGD control system is also acceptable. |

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| | tion System & Compressed Air System | | | tem as per manufacturer's standard practice. Ventilation System: Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of ventilation system .... | | |
| 476. | Section-VI (TS) Part-A Sub-section-III-A3 Fire Fighting System | 1.00.00, 1.5 b&c | 1 of 2 | b) All Conveyors and Cable Galleries shall be provided with Linear Heat Sensing Cable detectors.<br>c) All cable galleries shall be provided with Multisensor type detectors. | Please clarify the type of detector to be used in cable galleries i.e. Linear Heat Sensing Cable detector and /or Multisensor type detectors.<br>Also please clarify above requirement for the conveyor area related to cable rack. | As per specification clause 1.00.00, 1.5 b&c, Part-A, Sub-section-III-A3, it is envisaged that both Linear Heat Sensing detectors and Multisensor type detectors shall be provided for Cable galleries whereas only Linear Heat Sensing detectors shall be provided for conveyors. |
| 477. | Section-VI (TS) Part-A Sub-section-III-A3 Fire Fighting System | 1.2,1.3 | 1 of 2 | HVW Spray System: Automatic fire detection cum high velocity water spray system shall be provided for various transformers (having oil capacity 2000 liters or more) envisaged under this package. Tapping | Please clarify spray pumps to be provided for spray system or tapping will be provided from nearby existing header. | Specification requirement is amply clear. Tapping for HVW and MVW spray system shall be provided from nearby existing spray headers. |

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| | Section-VI (TS) Part-B Sub-section-I-M4 Fire Detection & Protection System | 3.01.00 | 1 of 18 | for HVW spray system shall be provided from nearby existing hydrant header.<br>MVW Spray System: Automatic fire detection cum medium velocity water spray system for the various cable galleries envisaged under this package. Tapping for MVW spray system shall be provided from nearby existing Spray header<br><br>HVW AND MVW SPRAY SYSTEM<br>General<br>It shall consists of Spray Pumps, Pressurization arrangements, water mains network, deluge valves, alarm valves, flow switches, isolation valves, Y type strainers.... | | |
| 478. | Section-VI | 1.00.00,1. | 1 of 2 | Five numbers each type | Bidder understands that, “Five | Bidder to refer relevant amendment. |

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| | (TS) Part-A Sub-section-III-A3 Fire Fighting System | 4 | | of Portable fire extinguishers consisting of water type, dry chemical powder type, C02 type shall be provided in various facilities of FGD system. | nos. each types" means 5 nos. CO2 type, 5 nos. DCP Type, 5 nos. water type to be provided in areas or to be distributed as per TAC's norms. Please confirm. | |
| 479. | Section-VI (TS) Part-A Sub-section-III-A5 Lime Stone & Gypsum Handling System | 2.01.01 | 2 of 6 | Limestone Handling Plant (LHP) Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers of Track Hopper of existing Coal Handling Plant (CHP). | Please clarify the terminal point between LHP and existing CHP. | The unloaded limestone will be fed to new limestone crusher house through series of new conveyors/bucket elevators before existing Crusher house of CHP. Exact terminal point shall be finalized based on the layout of FGD plant proposed by various bidders. |
| 480. | Section-VI (TS) Part-A Sub section-III-B Electrical System/ Equipment | 1.07.00 | 2 of 6 | DG set ( if applicable) | Please clarify whether the main power plant DG set spare capacity is available for FGD system emergency loads. If spare capacity is available in the main DG set, please indicate the capacity. | No emergency load of FGD area is envisaged in main plant DG. |
| 481. | Section-VI (TS) | 1.08.00 | 2 of 6 | Contractor shall provide cable trays and their ac- | The Cable tray, supports and tray earthing for contractor cables on | Technical specifications are clear. Bidder shall comply with technical specification requirement clause no: - 1.08.00.2. |

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| | Part-A Sub-section-III B Electrical System/Equipment | | | cessories with support arrangements, trestle, trenches, duct bank etc. as required for the cables under his scope of supply for the complete system. However the Cable tray, supports and tray earthing for contractor cables on employer cable vault shall be supplied by employer. | employer cable **trestle** shall be supplied by employer also. (Not limited to employer cable vault). Please confirm. | |
| 482. | Section-VI (TS) Part-A Sub-section-III B Electrical System/Equipment | 1.10.00 | 4 of 6 | Complete below ground earth mat and above ground equipment earthing system and lightning protection for the plant and equipment under contractors scope along with its interconnection to the nearest employers earth grid at two points. | Existing earth grid plan drawing nearby FGD and ESP area required for bidder's bidding design. Please provide. | The same shall be provided during detailed engg. However bidder may visit the project in order to get itself acquainted with existing electrical of plant |
| 483. | Section-VI (TS) Part-A Sub-section-IV | 1.13.01 | 3 of 3 | Electrical Terminal points of Contractor's electrical scope, applicable for all systems/ | Bidder understands incoming power cables from Terminals of Employers HT switchgear to 11kV FGD SWGR in FGD Area is Bidder's | The same shall be provided during detailed engg. However bidder may visit the project in order to get itself acquainted with existing electrical of plant |

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| | Terminal Points & Exclusions | | | subsystems described in relevant clauses for SCOPE is given below:<br>(i) Terminals of Employers HT switchgear. | scope of supply.<br>And according to this understanding, below data and plan drawing is required for bidding design for incoming power cable & raceway.<br>1. Each PJT's Main cable route plan including below information's<br>- Employers HT switchgear location.<br>- Existing employer's cable vault or trestle (main cable route) plan.<br>- Terminal points between "Existing employers cable vault or trestle" and "bidders new cable trestle for FGD system"<br>- Approximately Cable length from "Terminals of Employers HT switchgear" to "Terminal points on existing employer's cable vault or trestle for FGD interface".<br>Please provide. | |
| 484. | Section-VI (TS) Part-A Sub-section-V | 1.00.00 | 1 of 26 | Design Point<br><br>7. Flue Gas Composition at FGD system inlet: | Please check volume percentage of H2O at design point. This is too low value compared with normal practices. And summation of pro- | Bidder to refer necessary amendment in this regard. |

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| | Salient Design Data & Sizing | | | (iii) H2O (% v/v wet) : 3.958 | vided volume percentage of all gas composition is not 100%. | |
| 485. | Section-VI (TS) Part-A Sub-section-V Salient Design Data & Sizing | 2.00.00 | 3 of 26 | 7. Flue Gas Composition at FGD system inlet<br><br>(ix) SO3 (ppm) | Please clarify whether the SO3 concentration is dry condition or wet condition. | Specification requirement is clear under the referred cl.no. 2.00.00 . Bidder shall comply with the specification requirements. |
| 486. | Section-VI (TS) Part-A Sub-section-V Salient Design Data & Sizing | 2.00.00<br>3.00.00 | 3~6 of 26 | Salient Design Data<br>2.00.00 The FGD for MOUDA-II 2X660MW & TANDA-II 2X660MW, NABINAGAR-1 3X660MW, MEJA-1 2 X 660MW & BARH-1 3X660MW shall be designed to comply with the requirements stipulated under Guaran-tee point and Design point in the table below.<br><br>3.00.00 The FGD for SOLAPUR-II 2X660MW & MEJA-1 2 X 660MW shall be designed to comply | Please clarify which design data between 2.00.00 and 3.00.00 for MEJA-1 2X660MW shall be used for the design of FGD system for MEJA-1 2X660MW. | Bidder to refer necessary amendment in this regard. |

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| | | | | with the requirements stipulated under Guarantee point and Design point in the table below. | | |
| 487. | Section-VI (TS) Part-A Sub-section-V Salient Design Data & Sizing | 7.03.00, 2.0 | 13 of 26 15 of 26 | Note: Dry bulb temperature during summer = 45 Deg C. | In clause No. 7.03.00, 2.0 of SUB SECTION-V Salient Design Data: It is mentioned that Dry Bulb Temperature during summer = 45 Deg C. However in Appendix – A of same subsection individual project wise dry bulb temperature are also indicated. Please confirm which dry bulb temperature for summer to be followed for air conditioning system design. | Bidder to refer clause 7.01.00 (1) of sub section-V, Part A of Section VI for air conditioning system design, Appendix -A to be considered. |
| 488. | Section-VI (TS) Part-A Sub-section-V Salient Design Data & Sizing | 8.04.00.ii) | 19 of 26 | Alarms from the FGD fire alarm panel shall be repeated simultaneously in repeater panel at Fire station. Also the fire alarms of this area have to be communicated to the main plant Fire alarm control panel through | Please provide details of existing fire alarm repeater panel at fire station and main plant Fire alarm control panel at main power house control room e.g. what interface protocol need to be considered, length and location etc. | It is clarified that potential free contacts for Fire Alarms to be provided in the FGD Fire alarm panel. So interface protocol, length and location is not required. |

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| | | | | potential free contacts. | | |
| 489. | Section-VI (TS) Part-A Sub-section-V Salient Design Data & Sizing<br><br>Section-VI (TS) Part-B Sub-section-I-M1 Flue Gas De-sulphurisation System | 10.09.00(i)<br><br>14.09.00 | 23 of 26<br><br>35 of 51 | More than 2.0 tonne or more than 10.0 m lift or hoists coming outside buildings- Motor driven for both travel & lift.<br><br>Contractor shall provide motorized hoist and trol-leys for all items requiring maintenance and weigh-ing 500 kg or more. | Please clarify the minimum weight of item for which motor-ized hoist is to be considered as there is ambiguity. | Technical specifications are clear. Bidder shall comply with the requirements of technical specification pertaining to the area specified. |
| 490. | Section-VI (TS) Part-A Sub-section-V Salient Design Data & Sizing | 5.01.00 | 8 of 26 | Wet chimney installed downstream of the wet FGD system | Please confirm whether there is any requirement of elevator in the wet chimney. | Rack and pinion type elevator is required to be provided inside the chimney. Refer clause 3.14.01 & 3.14.11 of sub-section IVD, Part-B, Section VI in this regard |
| 491. | Section-VI (TS) Part-A Sub-section-V | 5.01.00 | 8 of 26 | The chimney flue liner cladding shall be of 2mm thick Titanium (Grade 2 as per ASME SB265) or C- | Please confirm whether alterna-tive material such as Borosilicate block / Acid brick / Fiber Glass Re-inforced Plastic can be used in | Bidder to refer necessary amendment in this regard. |

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| | Salient Design Data & Sizing | | | 276 alloy over 8mm. thick mild steel base plate of flue liner. | place of Titanium or C-276 alloy. | |
| 492. | Section-VI (TS) Part-A Sub-section-V Salient Design Data & Sizing | 11.01.00 | 25 of 26 | The coal conveyor shall also be suitable for handling limestone unloaded at wagon tippler / track hopper & being conveyed to limestone crusher house... | Please clarify how the existing coal conveyor can be used as limestone conveyor too. | Bidder's query is not clear. |
| 493. | Section-VI (TS) Part-A Sub section VII Mandatory Spares | 1.18.00<br>1.24 (R )<br>1.27 | 11 of 61<br>42 of 61<br>60 of 61 | Good Cum Passenger Elevator<br>Elevator<br>Chimney Elevators | For Mandatory spares Bidder has considered following clauses for respective elevator<br>• Cl 1.18.00 for spares for Absorber Elevator,<br>• Cl 1.24( R ) for Limestone Crushing System Elevator,<br>• Cl 1.27 for Chimney Elevator, if applicable<br>Please confirm respective clauses. | For Mandatory spares Bidder shall consider the following clauses for respective elevator<br>• Cl 1.18.00 for spares for Absorber & Limestone Grinding system building Elevator,<br>• Cl 1.24( R ) for Limestone Crushing System Elevator,<br>• Cl 1.27 for Chimney Elevator |
| 494. | Section-VI (TS) Part-B Sub-Section-I-M1 Flue Gas De- | 3.01.00<br><br><br><br>16.01.03 | 5 of 51<br><br><br><br>33 of 51 | 1. Design internal pressure at 67% yield strength (mm wc): +660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), which- | Please clarify Duct design Pressure. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | sulphurisation System | | | ever is higher<br><br>Duct Design Pressure : All flue gas ducts shall also be designed for ± 660 mm w.g., or maximum conceivable pressure of the relevant fans, which-ever is higher at 67% of yield strength of material | | |
| 495. | Section-VI (TS) Part-B Sub-section-I-M1 Flue Gas De-sulphurisation System | 15.01.00 | 36 of 51 | (ii) De-sign/Construction/Installation Codes<br>Latest addition of IS:14665(all parts) and also meeting any addi-tional requirements of IS:4666, IS:1860 and IS:3534 | IS: 14665(all parts) supersedes IS: 4666, IS: 1860 and IS: 3534. Hence we will refer only IS: 14665(all parts).<br>Please confirm | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 496. | Section-VI (TS) Part-B Sub-section-I-M1 Flue Gas De-sulphurisation | 15.06.00 | 38 of 51 | Provide Special corrosion resistant treatment on all elevator components. The protective treatment shall be subject to Em-ployer's Approval. | Please clarify the type of corro-sion resistant treatment to be provided over the elevator com-ponents room if there is any spe-cific requirement as such. | Same will be discussed with the successful bidder during the de-tail engg. stage. |

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| | System | | | | | |
| 497. | Section-VI (TS) Part-B Sub-section-I-M2 Air Conditioning and Ventilation System | 3.01.00 3.02.00 | 1 of 26 | Unitary Air Filtration (UAF) units of min. capacity 75,000 m3/hr. or capacity calculated considering 8 air changes per hour whichever is higher, shall be provided for Non-Air Conditioned areas of FGD and ZLD (as provided) control building (e.g. Switch gear rooms, cable galleries, etc.)<br><br>MCCs and Switchgear room etc.<br>Supply air fan<br>Back draft dampers | In clause no. 3.01.00 it is mentioned that UAF type ventilation should be provided for Switch gear rooms.<br>However in clause 3.02.00 a table is provided wherein it is mentioned to provide supply air fan and back draft dampers for MCCs and Switch gear room. Please confirm the type of ventilation to be used. | Bidder to refer relevant amendment in this regard. |
| 498. | Section-VI (TS) Part-B Sub-section-I- | 5.15.00. Note-3, | 13 of 18, | Over and above, contractor may note that short term fire proof cables shall be provided for coal | As Inert gas system is not specified in scope of work in FGD & ZLD area, the Bidder does not need consider inert gas system. | Bidder's understanding is correct. Amendment will be issued in this regard. |

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| | M4 Fire Detection & Protection System | 5.18.00.ii) | 14 of 18 | handling plant and inert gas protected areas. Short term fire ..... Cross zoning of the signal from two adjacent multi sensor detectors shall be employed to initiate the fire extinguishing system of inert gas protected areas and... | Please confirm. | |
| 499. | Section-VI (TS) Part-B Sub-section-I-M4 Fire Detection & Protection System | 7.06.00 | 16 of 18 | Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam.... | As foam system will not be required, water monitors also not required either. Please cofirm. | Bidder to note that this is a general requirement regarding painting. Hence painting shall be applicable as per scope of supply and services mentioned in Sub-section III-A3, Part-A of Technical specification, Section –VI. |
| 500. | Section-VI (TS) Part-B Sub-Section-I-M7 Zero Liquid Discharge System | 3.01.00 | 4 of 32 | To avoid scale buildup in the Brine Concentrator, calcium sulfate(seed) will be continuously circulated over the wetted surfaces in the Brine Concentrator | There are two methods to control and prevent scale formation on the heat exchange tube in thermal ZLD system. One is, as specified in the tender, Seed slurry method with atmospheric pressure operation. Another is Vacuum/Low temperature operation. | Vacuum/Low temperature operation, where no seed slurry is added and wastewater boil in low temperature due to vacuum condition, is acceptable provided such system meets the provenness criteria specified in tender. In case, the Bidder provides such |

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| | | | | | Seed slurry method uses $CaSO_4$ slurry injection to FFE. $CaSO_4$ scale will attach and grow on the surface of the injected $CaSO_4$ in steady of on the surface of heat exchange tube, which is the principle of scale prevention and control of Seed slurry method. In Vacuum/Low temperature operation, no seed slurry is added and wastewater will boil in low temperature due to vacuum condition. In low temperature, the solubility of $CaSO_4$ increases and scale potential of $CaSO_4$ decreases, which is the principle of scale prevention and control of Vacuum/Low temperature operation. Both methods are already proven in the treatment of FGD wastewater. However, in the tender, only seed slurry method is specified. Please clarify if the both scale control methods to participate in this project. | a system, all other associated system etc. shall be provided in line with the above reference project as proposed by the vendor. Further, the contractor shall provide all necessary support documents like P&IDs, Process calculation, Equipment Layouts, etc. of the Reference Project during detail engineering & same shall be provided for these projects also as a minimum.<br>Further, Contractor shall also comply with all other requirements like Design criteria, Redundancy of equipment, MOC, Guarantee etc. as specified in Technical specification. |
| 501. | Section-VI (TS) | 3.01.00 | 4 of 32 | The wastewater enters a | Deaeration/decarbonation tank is | Bidder to refer Sl. 500 of this Clarifica- |

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| | Part-B Sub-Section-I-M7 Zero Liquid Discharge System | | | feed tank to deaeration and decarbonation. | only needed to seed slurry method, because there is no system to remove $O_2$, $CO_2$ gas in wastewater. In Vacuum/Low temperature operation, vacuum operation of ZLD can remove the dissolved $O_2$, $CO_2$ gas in wastewater. | tion to Technical Specification. |
| 502. | Section-VI (TS) Part-B Sub-Section-I-M7 Zero Liquid Discharge System | 3.02.05 | 22 of 32 | 1. Falling film evaporator(FFE) and accessory equipment design;<br>d) Deaerator<br>h) Hydrocyclone<br>2. Seeding system | Only Seed slurry method needs deaerator, hydrocyclone and seeding system. Hydrocyclone and seeding system are needed to collect and inject $CaSO_4$ slurry, respectively. Vacuum/Low temperature operation do not need them. | Bidder to refer Sl. 500 of this Clarification to Technical Specification. |
| 503. | Section-VI (TS) Part-B Sub-Section-I-M7 Zero Liquid Discharge System | 3.02.05 | 27 of 32 | J). Seeding System<br>1). One (1) seeding system.<br>2). The seeding system shall be of proven type and the contractor shall submit the detail scheme for employer's approval. Reference list of previous installations for similar | We have references in Vacuum/Low temperature ZLD. When required, the reference list and certificates from client will be submitted. | Noted |

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| | | | | application shall also be furnished to the employer. | | |
| 504. | Section-VI (TS) Part-B Sub-section-I-M9 MDL | MDL 387 388 | 15 of 24 | GA Drawing & Datasheet of 12T Hoist for Ball Mill Building GA & Datasheet of 25T Hoist | Capacity of Hoist/crane shall be as per equipment weights/specification and shall be provided during the bidding stage. Please confirm | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 505. | Section-VI (TS) Part-B Sub-section-I-M9 MDL | 542 640 | 21 of 24 23 of 24 | MQP for Chimney Elevator MQP of Elevator( Rack & Pinion) | Both Elevators are same. Please confirm. | The type of elevator is same for chimney area and CHP area. For a single supplier, the testing and inspection requirements can be tied up in the single MQP. However, if there are two different suppliers, two nos. of MQP are required. |
| 506. | Section-VI (TS) Part-B Sub-section-II E1 General Electrical Specification | 2.03.00 | 4 of 7 | For 415V system, busduct assemblies shall be used for incoming connection from transformers to the switchboard and interconnecting sections between switchboards wherever transformer | Bidder suggests Power Cable can also be applied for incoming connection from transformer to the LV SWGR board depend on result of calculation for load demand. Please confirm. | Technical Specification is amply clear and to be complied. |

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| | | | | rating is 1000KVA or above. | | |
| 507. | Section-VI (TS) Part-B Sub-section-II E3 Medium Voltage Bus Ducts | 3.03.01 | 4 of 11 | Bus support insulators shall be interchangeable, high creep, high strength and made of fine glazed solid porcelain manufactured by wet process or high strength cast resin insulators. | Bidder suggests FRP can also be applied for material of insulator and bushing.<br>(FPR is normal practice in current industry for BUS Duct)<br>Please confirm. | Technical Specification to be complied. |
| 508. | Section-VI (TS) Part-B Sub-section-II E3 Medium Voltage Bus Ducts | 6.01.00 | 8 of 11 | d) Material of Insulator / Bushing → Porcelain / Cast Resin | Bidder suggests FRP can also be applied for material of insulator and bushing.(FPR is normal practice in current industry for BUS Duct)<br><br>Before : Porcelain / Cast Resin<br>After : Porcelain / Cast Resin / FRP<br><br>Please confirm. | Technical Specification to be complied. |
| 509. | Section-VI (TS) Part-B Sub-section-II | 2.14.04 | 4 of 6 | All cables shall be armoured type if laid in CHP area or directly buried. | If cable doesn't laid in CHP area or directly buried, Bidder can use unarmoured Single & Multi core cables with cable tray & conduit. | Bidder understanding is correct. |

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| | E4<br>LT Power Cables | | | | Please confirm | |
| 510. | Section-VI (TS)<br>Part-B<br>Sub-section-II<br>E5<br>LT Control Cables | 2.14.02 | 3 of 6 | All cables shall be armoured type if laid in CHP area or directly buried. | Same with above. | Bidder understanding is correct. |
| 511. | Section-VI (TS)<br>Part-B<br>Sub-section-II<br>E6<br>Cabling Earthing & Lightning Protection | 2.01 .04 | 2 of 69 | No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant. | Bidder understands “Main Plant” means TG & SG Area.<br>So, Sub zero level cable vault/trenches can be provided below control building/switchgear rooms in FGD system. Please confirm. | Bidder understanding is correct. |
| 512. | Section-VI (TS)<br>Part-B<br>Sub-section-II<br>E6<br>Cabling Earthing & Light- | 3.03.01 | 5 of 69 | Pipes offered shall be complete with fittings and accessories | 1. In case of applying Non-armoured Cable, Bidder shall use Flexible Conduit & Box connector for Equipment connection.<br>2. In case of applying armoured Cable, Bidder shall use Cable gland instead of using flexible | Bidder shall comply with technical specification. |

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| | ning Protec-tion | | | | conduit (with Box connector) for Equipment connection.<br>Please confirm | |
| 513. | Section-VI (TS)<br>Part-B<br>Sub-section-II E6<br>Cabling Earth-ing & Light-ning Protec-tion | 3.02.05 | 5 of 69 | Cable trenches shall be provided only in Switch-gear/MCC rooms. | Same with above. | Bidder understanding is correct. |
| 514. | Section-VI (TS)<br>Part-B<br>Sub-section-II E7<br>HT Cables | 2.16.04 | 4 of 6 | All cables shall be ar-moured type if laid in CHP area or directly bur-ied. | Same with above. | Bidder understanding is correct |
| 515. | Section-VI (TS)<br>Part-B<br>Sub-section-II E9<br>HT Switchgear | 1.00.00 | 1 of 39 | Motor Feeder: KW Rat-ing/ [System Vol* 1.732 * (Eff) *(Pf)] *1 .1 (at least) | Bidder understands KW Rating for Motor Feeder sizing is BHP(kW) value. (Not Name plate rating value for Motor.)<br><br>Please confirm. | Bidders understanding is not correct. Feeder sizing shall be done as per motro name plate kw rating at $50^0$ C.. |
| 516. | Section-VI (TS) | 1.01.01 | 1 of 58 | Lighting load of 50 kVA (Minimum) shall be con- | Tender SLD is Missing. | Please refer Amendment to Technical Specification. |

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| | Part-B Sub-section-II E10 LT Switchgear & LT Busduct | | | sidered on each section of main switchgears with incomer from transform-er as indicated in the tender SLD. | Please clarify this requirements. | |
| 517. | Section-VI (TS) Part-B Sub-section-II E10 LT Switchgear & LT Busduct | 1.04.00 | 2 of 58 | Standardization<br>It shall be preferred to have all LV Switchboards for the entire plant from a single manufacturer from maintainability and spares management point of view.<br>It shall be preferred to follow a standardization of Terminal Numbers across all LV Modules for ease of Interconnection and maintenance. | Bidder applies the unification for the LV SWGR within Bidder's scope of supply.<br><br>Please confirm. | Selection table of clause 43.01.00 to be referred. |
| 518. | Section-VI (TS) Part-B Sub-section-II E10 LT Switchgear & LT Busduct | 43.01.00 | 44 of 58 | Feeder Module, Other than Motor Selection Ta-ble (415 V AC) | Bidder understands Protection for LV MCC Feeder Module as below. Please confirm.<br>- Feeder rating 0 ~ 99Amp : Fuse Protection<br>- Feeder rating 100 ~ 400Amp : MCCB Protection | Selection table of clause 43.01.00 to be referred. |

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| | | | | | - Feeder rating 400 ~ 1120Amp : ACB Protection | |
| 519. | Section-VI (TS) Part-B Sub-section-II E10 LT Switchgear & LT Busduct | 43.02.00 | 44 of 58 | Motor Module Selection table | Bidder understands Protection for Motor Module on LV MCC as below. Please confirm.<br>- Motor rating 1.1 ~ 110 kW : Fuse Protection<br>- Motor rating 110 ~ 200 kW : ACB Protection<br>(MCCB is not used for Motor Module) | Selection table of clause 43.02.00 to be referred. |
| 520. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 3.00.00 (i)<br><br>8.02.03 | 2 of 19<br><br>10 of 19 | Fuel service tank 8 hours running<br><br>A day oil tank 990 litres fuel capacity shall be provided by Bidder | Bidder understands that bidder will supply both the tanks along with FO loading and unloading system.<br><br>Please confirm. | Bidder to provide 1 (one) day tank of 990 ltr fuel capacity along with FO loading and unloading system for each DG set |
| 521. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 5.03.00 | 3 of 19 | The alternator outgoing supply of DG set shall be fed into employer's breaker panel. | Bidder understands that the DGPCC will be scope of employers.<br><br>Please confirm. | The alternator outgoing supply of DG set shall be fed into FGD Emergency MCC which is under bidder's scope. Refer SLD and amendment |
| 522. | Section-VI | 6.01.01 | 4 of 19 | All DG sets shall be con- | Please clarify whether we have to | Min 1 (one) number of DG set common |

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| | (TS) Part-B Sub-section-II-E11 Diesel Generators | | | trolled independently through separate control panel. | supply (1w+1s) DG set for each unit or (1w+ 1s) DG set for all the units. | for entire FGD plant shall be provided by bidder for meeting emergency process loads envisaged for FGD plants. Refer tender SLD |
| 523. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 6.01.01 | 4 of 19 | It shall also have auto initiation through command from remote from Owner's panel. | Our understanding is not clear in this regard, whether Bidder's have to remotely connect all the DG Sets with their FGD control system or it will be connected to main station DCS under NTPC scope of supply.<br><br>Please clarify. | Bidders have to remotely connect all the DG Sets with their FGD control system. Refer amendment-1 to Technical Specification. |
| 524. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 7.00.00 | 6 of 19 | Diesel Generator control panel | Bidder understands that any kind of grid synchronization and earth fault protection will not be in bidder's scope.<br>Any earth fault protection is not considered.<br>We considered only 1 master trip relay for common fault both electrical & mechanical in our scope.<br>Please confirm. | Bidder to electrical protections as per technical specifications. Refer amendment-1 to Technical Specification. |
| 525. | Section-VI | 7.11.00 | 8 of 19 | Suitable 4 to 20mA trans- | Our understanding is not clear in | Please refer Amendment to Technical |

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| | (TS) Part-B Sub-section-II-E11 Diesel Generators | | | ducer with dual output shall be provided in control panel for voltmeter & frequency meter for Owner's use. | this regards. Please provide the requirement of these transducer in owner's panel. | Specification. |
| 526. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 7.12.00 | 8 of 19 | The bidder is required to provide coupling relay (with diodes) having 24V DC energising coil in the control panel for the following for owner's use: DG start/Stop, DG voltage raise/lowered, DG speed raise/lower, DG auto start. | Our understanding is not clear in this regards. Please clarify why owner requires these relays at owner's panel. | Refer amendment-1 to Technical Specification. |
| 527. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 8.04.01 | 10 of 19 | The radiators tubes shall be copper with sufficient heat transfer area. | As per manufacturer standard engine shall be provided with low carbon steel tubing and aluminium fins radiator core. Please confirm. | Technical specifications are clear. Bidder shall comply with technical specification requirements |
| 528. | Section-VI (TS) Part-B | 8.06.00(j) | 11 of 19 | Necessary foundation bolt and base channels for the engine, alternator, | As the DG set shall be supplied with specially designed AVM pad, foundation bolts is not applicable | Technical specifications are clear. Bidder shall comply with technical specification requirements |

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| | Sub-section-II-E11 Diesel Generators | | | fuel service tank and for all other equipment include this packae. | in LT (415 V) DG set. Please confirm if Bidder can proceed with above understanding. | |
| 529. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 9.02.01 | 12 of 19 | Voltage – 415V, Frequency – 50hz (+3 to -5%) | As per manufacture standard voltage variation shall be ±5% & frequency variation shall be ±3%. Please confirm. | Technical specifications are clear. Bidder shall comply with technical specification requirements |
| 530. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 12.01.03 | 18 of 19 | Check of fuel consumption – A check of the fuel consumption shall be made throughout the load run test. The fuel consumption should not exceed the design values. | As regards the fuel consumption test, kindly note that due variation of DG load specific fuel measurement test cannot be conducted at site, same can be done by tentative method only or we shall however provide the internal test report of manufacturer for specific fuel consumption. Please confirm. | Technical specifications are clear. Bidder shall comply with technical specification requirements |
| 531. | Section-VI (TS) Part-B Sub-section-II-E11 | 13.04.00 | 18 of 19 | Function test on DG set complete with AVR and speed governor. | As AVR and governor being the part of engine and alternator control so no separate functional tests for the same can be done. Please confirm. | Technical specifications are clear. Bidder shall comply with technical specification requirements |

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| 532. | Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators | 14.01.00 & 15.01.00 | 18 of 19 & 19 of 19 | Vibration test is to be carried out at site. Noise level measurement shall be done generally following the guidelines given in in IS: 12065. The measurement shall be carried out with a calibrated integrating sound level meter as per IS: 9779. This test is to be carried out at site. | Measurement of sound level and vibration test cannot be performed at site/works as there will other equipment vibrations. However the vibration shall be within the level of 250 micron and as per CPCB norms presently applicable with the acoustic enclosure reduction in the sound level shall be 25dBA. Please confirm. | Technical specifications are clear. Bidder shall comply with technical specification requirements |
| 533. | Section-VI (TS) Part-B Sub-section-II E12 Outdoor Transformers | 1.01.00 | 1 of 31 | OUTDOOR TRANSFORMER | Bidder suggests indoor service can also be applied for LV Transformer (11kV/0.4kV or 3.3kV/0.4kV) for this PJT. Please confirm. | Bidders query is not clear. |
| 534. | Section-VI (TS) Part-B Sub-section-II-E13 | 1.01.00 | 1 of 2 | All work shall be carried out as per the following standard/codes as applicable IS:4722, IS:325 | Since IS 4722 is not applicable for traction equipment, it shall not be applicable for Elevator motor. Please confirm. | Bidder's understanding is correct. Referred standard as applicable shall be followed in line with the technical specifications. |

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| | Elevator Electrical | | | | | |
| 535. | Section-VI (TS) Part-B Sub-section-II E15 Station Lightning | 3.02.02 | 4 of 16 | Emergency AC Lighting System<br>This system shall be provided for certain important areas in the main plant. | Bidder understands "Main Plant" means TG & SG Area. So, Emergency AC Lighting System is not applied for FGD Plant Area.<br>Please confirm. | Emergency AC lighting system mentioned in areas as per technical specifications to be provided. refer amendment-1 to Technical Specification |
| 536. | Section-VI (TS) Part-B Sub-section-II E15 Station Lightning | 3.03.04 | 5 of 16 | For Coal Handling plant./FGD Plant Area 100W, 220V DC Lighting fixture shall be provided in underground portion of conveyor, each switchgear room, control room, office room, pump house, ~~ | Please confirm that 'Strategic locations' where emergency DC lighting system shall be supplied for FGD Plant Area are as below.<br>- FGD SWGR Room<br>- FGD Control Room & Office, Control equipment rooms<br>- Staircases for FGD Elec & control BLDG<br>- Pump House | Bidder understanding is correct. However strategic location also include each floor of TP and TP staircase(if any) |
| 537. | Section-VI (TS) Part-B Sub-section-II E15 Station Lightning | 4.00.00.10 .(I) | 8 of 16 | Lighting Panels shall be of following types: | Please clarify the definition/usage of each type of lighting panels. | The definitions and its details have already been provided in technical specs |

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| 538. | Section-VI (TS) Part-B Sub-section-II E15 Station Lightning | 4.00.00.10 .(I) | 8 of 16 | Lighting Panels shall be of following types: | Please clarify the purpose of 3kVA transformer located inside of LP-3 type lighting panel itself. | LP-3 shall be used for feeding of RC receptacle as mentioned in technical specification. Kindly refer clause no:- 4.00.00.10.h |
| 539. | Section-VI (TS) Part-B Sub-section-II E15 Station Lightning | Annexure - A. | 15 of 16 | Annexure - A. | Please clarify average illumination Lux levels (or ratio (%) of fixture) to be adopted in certain area where Emergency AC, Normal DC, Emergency DC Lightings are installed. | Refer to Annexure-B in Station Lighting chapter. Amendment-1 issued |
| 540. | Section-VI (TS) Part-B Sub-Section IV-D Civil Works | 3.14.00 | 10 of 69 | Single flue or multiple flue chimneys to be provided | Bidder suggests that this chimney might not be necessary. Please confirm. | Bidder shall comply to the requirements of technical specification. |
| 541. | Section-VI (TS) Part-B Sub-Section IV-D Civil Works | 12.00.00 (Roads) | 30 of 69 | Concrete pavement for roads shall be min. 250mm thick slab | Please clarify which particular specification about roads needs to be followed. | Query is not clear |

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| | | | | | | |
| 542. | Section-VI (TS) Part-B Sub-Section IV-D Civil Works | 12.00.00 | 31 of 69 | Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete. | Please clarify which particular specification about roads needs to be followed. | Query is not clear |
| 543. | Section-VI (TS) Part-B Sub-Section IV-D Civil Works | 21.00.00 | 41 of 69 | RCC paving of min. 150mm thick with M25 grade concrete | Please clarify which particular specification about roads needs to be followed. | Query is not clear |
| 544. | Section-VI (TS) Part-B Sub-Section IV-D Civil Works | 29.02.00 | 48 of 69 | Interconnecting walkway between various structures, buildings & facilities shall be finished with 22mm chequered concrete tiles | Please confirm - between which structures / buildings are interconnecting walkways required? Further, if the interconnecting walkways (if any) are steel structures, can we use steel chequered plate / gratings in place of chequered concrete tiles? | As the layout of FGD system is in Bidder's scope, ascertaining the requirement of Interconnecting walkway between various structures, buildings & facilities is in the scope of Bidder.<br>For finising schedule,Bidder shall comply with technical specification requirement. |
| 545. | Section-VI (TS) Part-B Sub-Section | 31.03.00 | 56 of 69 | All steel surfaces should be provided with two component moisture curing zinc silicate primer | What separate paint is required other than the primer, intermediate & final coat already provided in the shop? | For steel sections and structures which are to be transported on sea, anti-corrosive paint before shipment shall be provided to take care of sea worthiness. |

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| | IV-D Civil Works | | | coat, followed by polyamide curved epoxy (with MIO content) intermediate & aliphatic isocyanate curved acrylic final coat, all in shop | Please clarify. | |
| 546. | Section-VI (TS) Part-B Sub-Section IV-D Civil Works | 31.07.00 | 57 of 69 | All steel sections & fabricated structures, which are required to be transported by sea, shall be provided with anti-corrosive paint before shipment to take care of sea worthiness | Same with above. | For steel sections and structures which are to be transported on sea, anti-corrosive paint before shipment shall be provided to take care of sea worthiness. |
| 547. | Section-VI (TS) Part-E List of Tender Drawings | ELECTRICAL SINGLE LINE DIAGRAM FOR FGD PACAKGE | 53 of 53 | GENERAL NOTE<br>11. Panel being used for feeding of CHP | Bidder understands scope of supply for cabling from 11kV FGD TIE SWGR to 11/3.45kV Exiting CHP/AHP TR as below. Please confirm.<br>- Power Cable: Supplied by FGD Supplier's<br>- Cable raceway: Supplied by employer.<br>(up to employer's trestle : Supplied by FGD Supplier's) | Refer amended tender SLD.<br>-Bidder shall comply with technical specification requirement clause no: - 1.08.00.2.However bidder may visit the project in order to get itself acquainted with existing electrical of plant. GLP of respective plants has already been attached. |

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| Sl. No. | Section/Part/ Chapter | Clause No. | Page No. | Bid Specification | Clarification sought by the bidder | NTPC CLARIFICATIONS |
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| 548. | Section-VI (TS) Part-E List of Tender Drawings | ELECTRI-CAL SIN-GLE LINE DIAGRAM FOR FGD PACAKGE | 53 of 53 | GENERAL NOTE<br>11. Panel being used for feeding of CHP<br><br>Panel being used for feeding of CHP/AHP HT transformer shall be suit-ably modified to DD type for feeding of 11kV FGD tie switchgear.<br>CHP/AHP HT transformer shall then inturn be fed from 11kV tie switchgear. Necessary cabling upto AHP/CHP transformers shall also be in scope of bidder. | For power cables from 11kV FGD TIE SWGR to 11/3.45kV Exiting CHP/AHP TR, below data and plan drawing is required for bidding design for incoming power cable & raceway.<br>1. Each PJT's Main cable route plan including below infor-mation's<br>- 11/3.45kV Exiting CHP/AHP TR location.<br>- Existing employer's cable vault or trestle (main cable route) plan for Cabling to 11/3.45kV Exiting CHP/AHP TR<br>- Terminal points between "Exist-ing employers cable vault or tres-tle" and "bidders new cable tres-tle for FGD system" for Cabling to 11/3.45kV Exiting CHP/AHP TR<br>- Approximately Cable length from "11/3.45kV Exiting CHP/AHP TR" to "Terminal points on exist-ing employer's cable vault or tres-tle for FGD interface".<br>- Rating of CHP/AHP TR for Cable | Refer amended tender SLD.<br>-Bidder shall comply with tech-nical specification requirement clause no: - 1.08.00.2.However bidder may visit the project in or-der to get itself acquainted with existing electrical of plant. GLP of respective plants has already been attached. |

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| | | | | | Sizng.<br><br>Please provide. | |
| 549. | Section-VI (TS) Part-E List of Tender Drawings | ELECTRI-CAL SIN-GLE LINE DIAGRAM FOR FGD PACAKGE | 53 of 53 | Spare for owners use | Please provide feeder rating, type and Q'ty for Spare for owners use feeder design per each bus sec-tion. | Shall be intimated during detail engineering. |
| 550. | General Que-ries | - | - | - | Please confirm questions below.<br>a. Can any additional cable / pip-ing / ducting load be taken from the existing structures?<br>b. Shall NTPC clear the FGD area of all debris prior to the con-tractor's start of work?<br>c. What is the lead distance for disposal of excavated debris?<br>d. Where there is a single dry chimney for 2 boilers, wheth-er there can be 1 no. wet chimney for the 2 correspond-ing FGD units? | D. Bidder to note that irrespective of number of chimney(s), there shall be one dedicated flue (liner) for each unit. |
| 551. | Section-VI (TS) Part-A, | 10.06.00 | 22 of 26 | - | NTPC to provide the Sieve analysis, BWI for limestone considered for the project as | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | Salient Design Data | | | | the same is not mentioned in the tender specification. | |
| 552. | Section-VI (TS) Part-A, Salient Design Data | 10.06.00 | 22 of 26 | - | As per the tender specification of lime stone handling system lump size (max.) of 400 mm (1 - 2%) has been specified, NTPC to please clarify whether entire system has to be designed for handling lump size of 400 mm . For example Crushers, belt conveyor & other equipment's etc. | Technical specifications is clear. Bidder shall comply. |
| 553. | Section-VI (TS) Part-A, Salient Design Data | 10.06.00 | 22 of 26 | | As per the tender specification of lime stone handling system lump size (max.) of 400 mm (1 - 2%) has been specified, please clarify the bucket elevator & side wall conveyor shall also be designed to handle that size of 400 mm. | Technical Specifications is clear. Bidder shall comply. |
| 554. | Section-VI (TS) | 10.06.00 | 22 of 26 | | Input to the crusher is 400 mm lump size (Maximum) 1 - | Technical Specifications is clear. Bidder shall comply. |

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| | Part-A, Salient Design Data | | | | 2% as specified in the specification, and output lime stone size shall be 20 mm. hence NTPC to please confirm that is single stage crushing or can go for two stage crushing also. | |
| 555. | Section-VI (TS) Part-A, Salient Design Data | Clause no.11.01.00 | 25 of 26 | | Please clarify the capacity of truck unloading system to limestone shed / silo. | The system shall be designed to handle trucks of 60 MT gross weight. Necessary amendment in this regard shall be issued. |
| 556. | Section-VI (TS) Part-A, Scope of Supply & Services | Clause no.1.00.00 | 1 of 6 | | Please provide the detail profile drawing of CHP & all relevant drawings of CHP. | General Layout Plan of the plants is already given in the tender documents. Other drawings like Coal Flow Diagram and Transfer Tower GA, if required, shall be provided to successful bidders. |
| 557. | Section-VI (TS) Part-A, Scope of Supply & Services | Clause no.1.00.00 | 1 of 6 | | Area for Limestone handling system has not been defined in the tender specification. NTPC is requested to identify additional space for limestone handling system | Space available for FGD and associated system is marked in the General Layout Plan drawings attached with the Technical Specifications. Bidder has to propose the layout for LHP & GHP to cater the |

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| | | | | | | requirement of FGD plant based on the layout of FGD system and existing facilities in the available space. |
| 558. | Section-VI (TS) Part-B, Scope of Supply & Services | Clause no.3.01.00 | 2 of 73 | | The complete truck unloading system must not have any underground structure /Facilities has been specified in the tender specification.<br>As for unloading from Wagon tippers to crusher house underground facilities are already there, we request NTPC to allow for underground hopper and underground unloading facilities from truck hopper to Crusher house to accumulate in the layout and looking at the space constraints. | Technical specifications is clear. Bidder shall comply. |

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| 559. | SECTION – VI, PART-A | SUB-SECTION-III-A1 FGD | 1.03.00 | 1 of 9 | The contractor shall also supply an auxiliary absorbent tank, common for the two units | Bidder understands that "two units" is a typographical error and auxiliary absorbent tank will be common for "all units" (either 3x800, 2x800, 3x660, 2x660, 4x250 MW etc.). Employer is requested to confirm on Bidders under- | Bidders understanding is correct. Refer necessary amendment in this regard. |

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| | | | | | | standsing. | |
| 560. | SECTION – VI, PART-A | SUB-SECTION-III-A1 FGD | 2.04.00 | 2 of 9 | The contractor shall terminate the flue gas duct (at a suitable point on the common flue gas duct to chimney upstream of the chimney terminal point and outside the chimney). | Bidder understands that, this point is not applicable for this projects as separate wet stack is offered as per tender requirement and the PFD of FGD enclosed in the Tender. Employer is requested to confirm on Bidder's understanding. | Refer necessary amendment in this regard. |

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| 561. | SECTION – VI, PART-A<br><br>SECTION – VI, PART-A<br><br>SECTION – VI, PART-B | SUB-SECTION-III-A1 FGD<br><br>SUB-SECTION-III-A5 Limestone & Gypsum Handling Plants<br><br>SUB-SECTION-I-M1 FGD | 3.01.01<br><br>2.01.11<br><br>6.02.01 | 2 of 9<br><br>3 of 6<br><br>21 of 51 | 2X100% Limestone storage silos each having minimum 24 hours storage capacity equivalent to the require rements of all the units.<br><br>Alternatively, suitable number of Limestone Storage Silos to store limestone equivalent to consumption of minimum 7 days. Suitable number of Belt feeders below silos shall be provided taking feed from silo and discharging onto onward conveyors/ Bucket elevators.<br><br>The Contractor shall provide 2X100% Limestone storage silos each silo having minimum 24 hours storage capac1ity | As there are space restrictions in all the sites, Bidder would like to propose the following:<br><br>**Option-A:** One (1) no. common limestone Silo to store the crushed limestone for 9 days instead of one (1) common silo for 7 days & 2 silos for 1 days (total 9 days).<br><br>**Option-B:** Two (2) no. common limestone Silos to store the crushed limestone for 4.5 days each instead of one (1) common silo for 7 days & 2 silos for 1 days (total 9 days).<br><br>Employer is requested to furnish their acceptance/comments on the above options. | Specification requirement is clear in referred sub-section clauses. Bidder shall comply with the specification requirements.<br><br>Refer necessary amendment for query on SUB-SECTION-III-A5 regarding Limestone Storage capacity in this regard. |

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| 562. | SECTION – VI, PART-A<br><br>SECTION – VI, PART-A | SUB-SECTION-III-A1 FGD<br><br>SUB-SECTION-I-M1 FGD | 2.06.00<br><br>7.04.03 | 2 of 9<br><br>26 of 51 | - Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor (**in Employers scope**). The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor being provided **by the Employer**.<br><br>- Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided **by the Employer**. | Bidder understandss that Gypsum transfer conveyors (from Vacuum Belt Filter outlet to Gypsum storage area) are in Bidders scope NOT in Employer scope as per Terminal Point chapter (Section-VI, Part-A, Sub-section-IV). Employer is requested to confirm on Bidders understandsing. | Refer necessary amendment in this regard. |
| 563. | SECTION – VI, PART-A | SUB-SECTION-III-A4 Equipment Cooling Water System | - | 1 of 3<br><br>3 of 3 | - FOR NABINAGAR - 3 X 660 MW & BARH-1(3 X 660)<br><br>- (FOR LARA STPP- 2 X 800 M'W,**KUDGI-2 X 800 MW,**GADARWARA -2 X 800 MW,DARLIPALI-2 X 800 MW,MOUC>A -II 2 X 660 MW,TANDA-11 -2 X 660 MW,MEJA-2 X 660 MW) | Bidder wishes to inform that Solapur (2x660 MW) project name is missing in the ECW system specification<br>Further Kudgi project is mentioned as 2x800 MW instead of 3x800 MW.<br><br>Employer is requested to clarify the above mis- | Necessary Amendement is being issued. |

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| | | | | | | match & missing project. | |
| 564. | SECTION – VI, PART-A | SUB-SECTION-III-A5Limestone & Gypsum Handling Plants | 2.01.01 | 2 of 6 | Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes | Bidder requests Employer to clarifi\y the following points:- Can Bidder decide the Limestone receiving Options (either Trucks or Indian Railway rake), If Yes, then Bidder will propose their preferred option in the Stage-I bid. If NOT, then please clarify which option (Trucks OR Indian Railway rakes) is applicable to which plants.Further please furnish the existing CHP drawings (Plan & Elevation) of the plant where Indian Railway rake option needs to be considered. | Technical Specifications is clear. Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes.<br><br>Road unloading facility shall be provided for all the plants under this package. Wherever feasible, railway unloading shall also be provided using existing Wagon Tippler / Track Hopper as detailed out in the Technical Specifications. |

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| 565. | SECTION – VI, PART-A | SUB-SECTION-III-A5 Limestone & Gypsum Handling Plants | 2.01.01 | 2 of 6 | All necessary modifications involving Mechanical, Electrical, C&I, Civil and Structural works in the existing CHP for taking feed to new limestone path shall be in the scope of the bidder. | Bidder requests Employer to furnish the following detail / clarifications:<br><br>1. Drawings (plan & elevation) of existing coal handling plants (Buildings/conveyors etc.)<br><br>2. As built drawings of CHP from Track Hopper to Crusher house, this is required in order to plan the tapping for limestone handling system of FGD.<br><br>3. As build foundation drawings of CHP from Track hopper till Crusher house is required in order to plan the tapping for limestone handling system of FGD.<br><br>4. Employer to confirm that the warranty for CHP | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |

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| | | | | | | after taking the necessary tapping for lime stone handling and warranty for any existing structures dismantled and re-built during execution of FGD shall remain with the respective CHP vendors. | |
| 566. | SECTION – VI, PART-A | SUB-SECTION-III-A5 Limestone & Gypsum Handling Plants | 3.08.00 | 6 of 6 | Gypsum from storage shed shall be loaded to user's trucks using front end loader/ pay loader. | Bidders understands that front end loader / pay loader is in Employer scope.<br>Employer is requested to confirm on Bidders understandsing. | Confirmed. |

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| 567. | SECTION – VI, PART-A | SUB-SECTION-IV Terminal Point & Exclusions | 1.02.00 | 1 of 3 | Un cleaned Flue Gas For each unit:<br><br>i) One tapping from the common Flue Gas Duct going towards the existing Chimney (in case of twin flue chimney).<br><br>ii) One tapping each from the two Flue Gas Duct going towards the existing Chimney (in case of single flue chimney). | Does Bidder have the flexibility to choose between single tapping / double taping as per layout constraints or it is fixed. Also the taping points shown in some of the layout drawing is fixed or bidder can propose as per the layout suitability.<br><br>Further Employer is requested to provide the details i.e. exact location, size and elevation of Terminal Points for all the projects. | Bidder can choose between single or double tapping based on the flow distribution and layout feasibility in case of twin flue chimney.<br><br>Bidder shall note that we have provided existing ID system drawing based on which Bidder shall decide the terminal points. |
| 568. | SECTION – VI, PART-A | SUB-SECTION-IV Terminal Point & Exclusions | 1.10.00 | 2 of 3 | Gypsum:<br>Outlet of Gypsum storage silo/shed | Bidder understands that as per Tender specification (Section-VI, Part-A, Sub-section-III-A5, Cl no. 3.07.00) Gypsum shall be stored in a shed. Employer is requested to clarify that which option (shed/silo) needs to be consider for | Technical Specifications is clear. One (01) number of covered storage shed for gypsum sufficient to store gypsum equivalent to gypsum generation of minimum 7 days at Design Point (Generation of all units to be considered) is envisaged. |

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| | | | | | | Gypsum storing. | |
| 569. | SECTION – VI, PART-A | SUB-SECTION-VSalaient Design Data & Sizing | 2.00.00<br>3.00.00 | 3 of 26<br>5 of 26 | - The Flue Gas Desulphurisation (FGD) System FOR MOUDA-II 2X660 MW, TANDA-II 2X660 MW, NABINAGAR-1 3X660 MW, MEJA-I 2X660 MW & BARH-I 3X660 MW shall be designed to comply with the requirements stipulated under Guarantee point and Design pciint' in the table below: - The Flue Gas Desulphurisation (FGD) System for SOLAPUR-II 2X660 MW & MEJA-I 2X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below | Please note that MEJA-I 2X660 MW is appearing in Cl. no. 2.00.00 & 3.00.000. Employer is requested Employer to clarify which Cl. No. is applicable for MEJA-I 2X660 MW. | Refer necessary amendment in this regard. |

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| 570. | SECTION – VI, PART-A | SUB-SECTION-V Salient Design Data & Sizing | 5.01.00 | 8 of 26 | The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired, for the complete load range of operation and the expected numbers of Steam Generator start-ups while designing the Chimney flue liner considering Steam Generator in operation both with & without FGD system in operation . | Bidder understands that the wet stack shall be designed when FGD is in operation only. During FGD bypass the flue gas shall be passes directly through the existing stack which is not lined.<br>Employer is requested to confirm on Bidders understanding. | Bidders understanding is correct. |
| 571. | SECTION – VI, PART-A | SUB-SECTION-VII Mandatory Spares | 1.19.00 & 1.21.00 | 12 of 61 & 18 of 61 | 11.19.00 : Air Conditioning & Ventilation System<br>1.21.00 : Air Conditioning & Ventilation System | The mandatory spare of Air Conditioning & Ventilation System is repeated in cl no. 1.19.00 & 1.21.00. Bidder requested Employer to clarify the same. | The referred clause 1.19.0.0 stands deleted. Bidder to refer amendment in this regard. |
| 572. | SECTION – VI, PART-B | SUB-SECTION-I-M1 FGD | 1.09.00 | 4 of 51 | The equivalent weighted average of sound level..... shall not exceed 85 dB(A). | Bidder understands that 85 dB(A) is not applicable for Ball Mill, Crusher & Compressor and the exact noise level shall be informed in the Stage-1 Bid. | Refer necessary amendment in this regard. |

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| 573. | SECTION – VI, PART-B | SUB-SECTION-I-M1 FGD | 3.02.04 | 6 of 51 | The duct from Absorber outlet to bypass duct shall be made of Carbon steel of minimum 7mm thickness ..... | Bidder understands that the Absorber outlet duct will be directly connected to the new wet stack instead of Bypass duct. Employer is requested to confirm on Bidder's understanding. | Bidders understanding is correct. Refer necessary amendment in this regard. |
| 574. | SECTION – VI, PART-B | SUB-SECTION-I-M1 FGD | 3.03.09 | 7 of 51 | The dampers shall be pneumatically operated and controlled.....of failure of the absorber spray system or the GGH. | Bidder understands that GGH is not applicable for this project. Employer is requested to confirm on Bidder's understanding. | Bidders understanding is correct. |
| 575. | SECTION – VI, PART-B | SUB-SECTION-I-M1 FGD | 5.04.00 | 16 of 51 | The pumps shall be designed to meet the stipulations of Clause No.9.00.00 of this Sub-Section. | Bidder understands that the Cl. No. 9.00.00 is a typographical error and the correct reference cl. No. is 8.00.00. | Bidders understanding is correct. |

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| 576. | SECTION – VI, PART-A<br><br>SECTION – VI, PART-B | SUB SECTION-III-A1<br><br>SUB·SECTION·I·M1 (FGD) | 3.01.02<br><br>6.05.01 | 2 of 9<br><br>22 of 51 | 2x100% wet horizontal ball mills with each mill sized to meet 110% of the maximum total limestone requirement of all the units at Design point.<br><br>There shall be 2X100% tube mills for grinding of limestone. Each mill shall be sized to meet 110% of the maximum limestone requirement of all the units in a project operating under the following conditions, all occurring together.<br>(i) Load Design point flow<br>(ii) Flow 110% of limestone requirement of two absorbers at Design point | Bidder understands that the Ball Mill is common for all absorbers units instead of two absorber. | Bidders understanding is correct. Bidder shall provide 2x100% wet horizontal ball mills with each mill sized to meet 110% of the maximum total limestone requirement of all the units at Design point. |

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| 577. | SECTION – VI, PART-BPART-A | SUB-SECTION-I-M1FGDSUB-SECTION-III-A1FGD | 7.07.07 &7.07.102 .06.00 | 28 of 51 &29 of 512 of 9 | The complete waste water neturilasition.....automated and controlled from the control room.- Adequate storage and feeding system.....contractor scope- Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level...- Automated lime feeding & dosing system for Neturalisation.... | Employer is requested to furnish the following:1) A detailed scheme for automated waste water neutralization system along with automated lime feeding and dosing system since same has not been shown in the Tender Drawing no. 0011-109-POM-A-003, Rev-A, Scheme of Gypsum Dewatering System. 2) Please let us know the bulk density of Hydrated lime and weather this lime (supplied by Employer) will be in the form of bags or transported through trucks. 3) As Employer is arranging the Hydrated lime unto lime storage building (in Dewatering area) / ZLD, so this point needs to be incorporated in the Terminal Point | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | | | | | | Chapter (Section-VI, Part-A, Sub-section IV, Terminal Points & Exclusions).4) Bidder understands that the lime will be manually feed to the Bucket elevator from the lime storage room. | |
| 578. | SECTION – VI, PART-B | SUB-SECTION-I-M1 FGD | 13.01.00 & 13.03.07 | 33 of 51 & 34 of 51 | - Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness<br>- Additional Corrosion al- | Both clauses are contradictory to each other. Employer is requested to clarify which clause needs to be considered. | Refer necessary amendment in this regard. |

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| | | | | | lowance of 3mm on the minimum tank shell thickness | | |
| 579. | SECTION – VI, PART-B | SUB-SECTION-I-M1 FGD | 16.01.03 | 39 of 51 | All flue gas ducts shall also be designed for ± 660 mm w.g., or maximum conceivable pressure of the reh3vant fans, whichever is higher at 67% of yield strength of material | Bidder understands that, the FGD is designed for +660 and -150 mmwc or maximum conceivable head of Booster fan, whichever is higher, as per cl. No. 3.01.00 of same sub-section (pg. 5 of 51). Employer is requested to confirm on Bidder's understanding. | Refer necessary amendment in this regard. |
| 580. | SECTION – VI, PART-A<br><br>SECTION – VI, PART-E | SUB-SECTION-III-A1 FGD<br><br>Drawing No. : 0011-109-POM-A-003, Rev-A | 5.04.00<br><br>- | 5 of 9<br><br>- | 2x100% pump shall be provided to supply wash water (for cake washing as well as belt cloth washing) to the belt filters. In addition, 2x100% Filtrate water pump (common for all units) shall be provided to recycle the filtrate to the absorber. | Bidder clarifies that Filtrate water (from Filtrate water tank) can not be used for belt & cloth washing as filtrate may contain solids. Process/Make-up water (from process water pump) shall be used for belt cloth washing. Hence Bidder do | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | | (Scheme of Gypsum De-watering System) | | | 2x100% Belt & Cloth wash water pump (going to belt filter) | not envisage 2x100% belt & cloth wash water pumps as indicated in the specification & drawings. Employer is requested to confirm on Bidders above clarification. | |
| 581. | SECTION – VI, PART-A<br><br>Section VI part B | Sub-section-III A-1<br><br>Sub section-I-M1 | 6.02.00<br><br>7.08.02 | 5 of 9<br><br>29 of 51 | - The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.).<br><br>- The contractor shall provide 2 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours. | There is a contradictory in the specification, so Employer is requested to clarify the no. of pumps to be considered. | Refer necessary amendment in this regard. |
| 582. | SECTION – VI, PART-B | Sub section- I-M1 | 5.06.10 | 19 of 51 | The raw gas inlet duct of the absorber shall be equipped with a flushing device which shall operate continuously as well as in- | Bidder understands that this clause (flushing device) means emergency quenching, Employer to clarify on Bidders under- | Bidders understanding is not correct. |

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| | | | | | termittently. | standing. | |
| 583. | SECTION – VI, PART-B | SUB-SECTION - I-M1 - FGD System | 6.05.07 | 23 of 49 | The ball mill shall be driven by a motor through a peripheral gear. An auxiliary motor shall also be provided for inching of mills after trip and during maintenance. | Bidder understands that Peripheral/central drive system with motor shall be provided as per clause no. 3.01.06 vi) of section - VI, Part - A & Sub section - III A - 1, page 3 of 9. Employer is requested to confirm on Bidders understanding. | Bidder's understanding is correct. |
| 584. | SECTION – VI, PART-A | SUB-SECTION-I INTENT OF SPECIFICATION | 1.01.00-d | 1 of 19 | d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required | Bidder will furnish the necessary technical drawings/documents enabling Employer to take clearance from statutory authorities. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 585. | SECTION-VI; PART-B | SUB-SECTION-I-M6 Limestone & gypsum Handling System | 3.5.0 | 3 of 73 | Double conveyor stream shall be provided for conveying dewatered gypsum from gypsum vacuum belt filter to over ground storage under a shed **near plant** | Bidder understands that as per this clause the Gypsum shall be stored near the Plant Boundary, so Employer is requested to furnish the exact location | Space available for FGD and associated system is marked in the General Layout Plan drawing attached with the Technical Specifications. Bidder has to propose the layout |

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| | | | | | **boundary**. | of Gypsum storage area (near plant boundary) in the layout drawing for all 11 projects. | for LHP & GHP including storage area to meet the requirement of FGD system and existing facilities. |
| 586. | SECTION – VI, PART-B | SUB-SECTION-I-M1 | 1.06.00 | 4 of 51 | The Contractor shall offer the best design to accommodate the Flue Gas Desulphurisation (FGD) System and Lime stone & Gypsum handling & storage system within the confines of the space available. The location of FGD System and associated facilities shall be decided by the Bidder after visiting the Project site. | Bidder understands that Bidder will be allow to use space which is not highlighted in project specific tender drawings as "Space for FGD", based on dismantling of some facilities if required. Bidder request Employer to confirm the same. | Specification requirement is clear. Bidder shall comply with the specification requirments.<br><br>Bidder to refer the revised GLP in issued amendments. |

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| 587. | SECTION – VI, PART-B | SUB-SECTION-I-M6 (LHP) | 3.1.0 | 2 of 73 | Unloading, Crushing and Bunker Feeding System:----------<br>Alternatively, Two (2) numbers Box feeders/ Bulk material receiving unit/ Truck unloading system/ Surface feeder for unloading of limestone from trucks/ self-tippling trucks/ loader shovels, This unit shall feed limestone onto the conveyor before crusher house. The complete truck unloading system must not have any underground structures/facilities.<br><br>Limestone Handling Plant (LHP)----------<br>Two (2) numbers Box Feeders/ Bulk-material Receiving Unit/ Underground Truck Unloading Hopper | Both statement mentioned in two clauses are contradictory to each other. Bidder request Employer to clarify whether underground hopper for unloading the Truck can be used inline the clause 2.01.01 of Sub section -III-A5 of Section VI Part A. | Noted. Necessary amendment shall be issued. |
| | SECTION-VI, PART-A | SUB-SECTION-III-A5 | 2.01.01 | 2 of 6 | | | |
| 588. | SECTION – VI, PART-B | SUB-SECTION-I-M1 | 6.05.01 | 22 of 51 | There shall be 2x100% tube mill for grinding of lime- | Bidder understands that the offered mill are "Ball | Bidder's understanding is correct. |

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| | | (FGD) | | | stone. | Mill" not "Tube mill" as mentioned in this clause. | Refer necessary amendment in this regard. |
| 589. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 3.01.04 | 3 of 9 | 2x100% limestone slurry pumps for each absorber connected to each of the limestone slurry tank (total 4 nos. of pumps for 2x800 MW). Each pump catering to slurry requirement of each unit's absorber. | Bidder understands that this "2x800 MW" is mentioned only as an example. However for each Absorber 2x100% reagent feed pump is required. Employer is requested to confirm on Bidders understandsing. | Bidder's understanding is correct. |
| 590. | SECTION-VI PART-B | SUB-SECTION-I-M1 (FGD) | 6.07.03 | 24 of 51 | The slurry pipes shall be lined with replaceable wear resistant natural rubber of min. 10 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends. | Bidder shall envisage 6 mm thick rubber lined Carbon steel pipes for slurry applications. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 591. | SECTION-VI PART-B | SUB-SECTION-I-M1 (FGD) | 8.07.00 | 30 of 51 | For Absorber Recirculation service a Silicon Carbide impeller and SiC lining for casing can also be accepted if manufacturer has supplied a similar pump for a previous installation for | Bidder also proposes the Absorber recirculation pump impeller with Hi-chrome/ Duplex Stainless steel material and SiC lining for casing as per manufacturer's proven | Bidder's understanding is correct.<br>Refer necessary amendment in this regard. |

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| | | | | | similar service. | practice in similar applications. | |
| 592. | SECTION-VI PART-B | SUB-SCTION-I-M1 (FGD) | 12.03.00 | 33 of 51 | The isolation valves provided in all slurry lines shall be of knife gate/ butterfly type. | Bidder shall also propose diaphragm valves as per bidder's proven supply in similar service for valve sizes lower than 2". | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 593. | SECTION-VI PART-B | SUB-SECTION-I-M2 (AIR CONDITIONING AND VENTILATION SYSTEM) | 3.01.00 | 1 of 26 | Unitary Air Filtration Unit (UAF) of min. capacity 75,000 m3/hr. or capacity calculated considering 8 air changes per hour, whichever is higher, shall be provided for non-Air Conditioned areas of FGD and ZLD (as provided) control building (e.g. Switchgear rooms, cable galleries etc.). | Bidder shall envisage Mechanical ventilation (Supply air fan and back draft louvres) in Non-Air Conditioned area of FGD and ZLD control building (like MCC and switchgear rooms) as per specification clause no. 3.02.00. Employer is requested to confirm on Bidders understandsing. | Specification requirement is amply clear. Accordingly, Evaporative type ventilation system shall be provided for non-AC area of FGD/FGD cum ZLD Control room building . Bidder to refer relevant Amendment in this regard. |
| | | | 3.02.00 | 2 of 26 | All non-air conditioned areas shall be ventilated by a combination of supply/ exhaust fans and fresh air intake/ back draft louvres: | | |

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| | | | | | ii) MCC and Switchgear rooms: Supply air fan and back draft dampers | | |
| 594. | SECTION-VI PART-B | SUB-SECTION-I-M1 (FGD) | 6.05.01 | 23 of 51 | Limestone bond index: 13 kWh/ sh. Ton | Both clauses are contradictory to each other, so Employer is requested to clarify the same, which data shall be considered by Bidder. | Limestone Bond Index : 13 kWh/Sh.T (Min.) shall be followed. |
| | SECTION-VI PART-A | SUB-SECTION-V SALIENT DESIGN DATA AND SIZING | 6.00.00 | 10 of 26 | Bond index 13 kWh/t | | |
| 595. | SECTION-VI PART-A | SUB-SECTION-VII MANDATORY SPARES | 1.01.00 | 5 of 61 | Booster fan impeller Liners: 1 sets<br><br>Booster fan casing liners: 1 set | Same is not applicable, hence bidder shall not envisage any spares for these items. | These spares may be applicable based on the offered fan design. |
| 596. | SECTION-VI PART-A | SUB-SECTION-VII MANDATORY SPARES | 1.07.00 | 7 of 61 | Gear box: 1 no. of each type and size | Same may not be applicable for pumps which are V-belt driven, hence bidder shall not envisage any spares for these items for V-belt driven pumps. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 597. | SECTION-VI PART-A | SUB-SECTION-VII MANDATORY SPARES | 1.17.00 | 11 of 61 | Casing Liners: 1 set of each type | Same shall not be applicable for water pumps since there is no wear resistant liners on casing, hence | Bidder's understanding is correct.<br>Refer necessary amendment in this regard. |

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| | | | | | | bidder shall not envisage any spares for these items for water pumps. | |
| 598. | SECTION-VI PART-B | SUB-SECTION-I-M8 (Low Pressure Piping) | 1.13.00 | 2 of 16 | Drains and vents: No option for Butterfly valve. | Butterfly valve shall also be envisaged for slurry drain application. Bidder shall envisage Knife Gate/ Diaphragm valves (Diaphragm valves for sizes lower than 2") as well for similar application. | Provisions of Technical specification are clear. Bidder shall comply with the same. |
| 599. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 4.4.3<br><br>2.4.4 | 8 of 73<br><br>37 of 73 | Provision for alternative manual operation shall also be made using declutchable hand wheel of 500 mm diameter.<br><br>Minimum Hand wheel diameter: 500 mm | Bidder understands that 500 mm hand wheel diameter is a typical figure. Same might not be maintained for all Flap gates used in Limestone Handling plant. Bidder is free to select hand wheel size as per the recommendation of equipment manufacturer. | Technical Specifications is clear. Bidder shall comply. |

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| 600. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 4.4.3<br><br>2.3.3 | 8 of 73<br><br>37 of 73 | All the actuators in the plant should be selected based on heaviest loading, but the rating should not be less than 2500 kg with a lever arm of 1.0 m in any case.<br><br>Minimum Actuator rating: 2500 kg with 1.0 m lever arm | Bidder understands that 2500 kg is a typical figure. Same might not be maintained for all Flap gates used in Limestone Handling plant. Bidder is free to select actuator size as per the recommendation of equipment manufacturer. | Technical Specifications is clear. Bidder shall comply. |
| 601. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 4.4.3<br><br>2.4.5 | 9 of 73<br><br>37 of 73 | The diameter of the shaft shall not be less than 150 mm.<br><br>Flap gate shaft diameter: minimum 150 mm | Bidder understands that 150 mm shaft diameter is a typical figure. Same might not be maintained for all Flap gates used in Limestone Handling plant. Bidder is free to select shaft diameter as per the recommendation of equipment manufacturer. | Technical Specifications is clear. Bidder shall comply. |
| 602. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 1.2.0 | 28 of 73 | Maximum slope: 16 deg. | As per IS 8730: 1997 maximum allowed inclination angle for Belt Conveyor handling limestone shall be 18 deg. Hence bidder | Technical Specifications is clear. Bidder shall comply. |

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| | | | | | | propose 18 deg. inclination angle for the Belt conveyor selection. | |
| 603. | SECTION-VI PART-A | SUB-SECTION-III A1FGD | 3.01.06 | 3 of 9 | Each mill shall be complete with the following items:Complete lubricating system with appropriate lubricating medium storage facility (i.e. 1 no. lube oil tank for storage of lube oil and/or 1 no. grease storage drum as required). | Bidder shall envisage common lube oil system for two (2) mills as per bidder's proven practice. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 604. | SECTION-VI PART-A | SUB-SECTION-III A1 FGD | 23.01.00 | 8 of 9 | Each booster fan shall be provided with bearing lubrication and hydraulic blade pitch control unit(s). | Bidder shall envisage common lubrication system for two (2) booster fans as per bidder's proven practice. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 605. | SECTION-VI PART-B | SUB-SECTION-I<br>M1 (FGD) | 3.03.01 | 7 of 51 | A gas tight motor operated Guillotine gate shall be provided by the Contractor in the bypass duct (flue gas duct connecting to existing chimney). | Bidder shall not envisage any Guillotine gate damper at the bypass damper for isolation. Same shall be Quick acting bi-plane damper as per clause no. 3.03.07 mentioned in Sub-section-I M1 (FGD) under Technical Specification Section VI Part B.<br>Same shall be provided with a common 2x100% seal air system and shall be acting like an isolation damper (complete isolation,100% leak proof with seal air fan under operation) to isolate the bypass duct during FGD loop is under operation.<br><br>Further In case of single point tapping, one Guillotine gate shall be provided additionally at the tap- | Specification requirement is clear under the referred cl.no. 3.03.01 . Bidder shall comply with the specification requirements. |

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| | | | | | | ping from existing duct coming from ID Fan.<br><br>Employer is requested to comment/confirmation on above clarification. | |
| 606. | SECTION-VI PART-A | SUB-SECTION-III A5 LIMESTONE AND GYPSUM HANDLING PLANTS | 3.03.00 | 6 of 6 | Minimum **four (2) nos.** sump pumps in gypsum storage shed... up to disposal point. | Employer to clarify the same, which one is the correct data to consider: four (4) nos. or two (2) nos. pumps. | The number of sump pump shall be read as four (4). Necessary Amendment shall be issued. |
| 607. | SECTION-VI PART-A | SUB-SECTION-V SALIENT DESIGN DATA AND SIZING | 5.01.00 | 8 of 26 | External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium/ C276 sheet over insulation. | Employer to clarify the requirement for insulation over wet stack. Bidder shall not envisage any insulation over wet stack since same is a wet stack and cladded with 2 mm thick Titanium/ C276. | Thermal insulation as specified in Clause No. 3.14, subsection IV-D, Part-B, Section VI shall be provided by the bidder. |

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| 608. | SECTION-VI PART-A | SUB-SECTION-VII MANDATORY SPARES | 1.04.00 | 6 of 61 | Absorber Liner material: 5% coverage of each material and thickness for one unit/Absorber | Absorber shall be provided with 2 mm thickness cladding/ wall paper of Alloy C276/ Alloy 59. Hence bidder shall not envisage any spares for Absorber liners which are supposed to be valid only for rubber lined absorber. Employer is requested to confirm on Bidders understandsing | Refer necessary amendment in this regard. |
| 609. | SECTION-VI PART-A | SUB-SECTION-IV TERMINAL POINTS AND EXCLUSIONS | 1.14.00 | 3 of 3 | Instrument air at one point (if required) | Bidder shall envisage 2x100% Air Compressors to meet the instrument air and service air requirement for all the equipment's/ plant/ systems for FGD plant and ZLD plant (applicable wherever) as per clause no. 9.01.00 mentioned in Sub-section-V (Salient Design Data and Sizing) under Technical Specification Section VI Part A. Hence there will be | Bidder's understanding is correct. Amendment will be issued in this regard. |

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| | | | | | | no further supply of instrument air is required at terminal point.<br>Employer is requested to confirm on Bidders understandsing. | |
| 610. | SECTION-VI PART-A | SUB-SECTION-III A5 LIMESTONE AND GYPSUM HANDLING PLANT | 2.01.11 | 3 of 6 | Suitable number of Belt feeders below silos shall be provided taking feed from silo and discharging onto onward conveyors/ Bucket elevators. | Bidder shall envisage Vibrating feeders in place of Belt feeders as per bidder's proven practice. | Noted. Bidder to refer amendment in this regard |
| 611. | SECTION-VI PART-A | SUB-SECTION-V SALIENT DESIGN DATA AND SIZING | 9.01.00 | 21 of 26 | The heat exchangers are DMCW cooled and the maximum cooling water temperature at compressor coolers inlet to be considered same as that of PHE outlet cooled DMCW temperature. | Bidder understands that the compressor shall be either air cooled or water cooled as per their proven supply. | Specification requirement is clear under the referred cl.no. 9.01.00 . Bidder shall comply with the specification requirements. |

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| 612. | SECTION-VI PART-C | GENERAL TECHNICAL REQUIRE-MENTS | 30.00.00 | 42 of 83 | The equivalent "A" weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/ machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA. However for Ball Mills the noise levels as per following shall also be acceptable:<br>a) Ball Mill: < 90 dBA | As per clause no. 9.01.00 mentioned in Sub-section-V (Salient Design Data and Sizing) under Technical Specification Section VI Part A, Noise level shall not exceed 90 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor for Air Compressor. Hence bidder shall follow the same noise level limit for Air Compressor as well and same will be applicable for Limestone Crushers as mentioned below:<br><br>b) Air Compressor: < 90 dBA<br>c) Crusher: < 102 dBA<br><br>Employer is requested to confirm on Bidders understandsing. | Bidder to refer necessary amendment in this regard. |

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| 613. | SECTION-VI PART-B | SUB-SECTION-I M6 (Limestone Handling Plant) | 3.3.0 | 3 of 73 | In limestone crusher house, limestone from each incoming Conveyor shall pass through two (2) numbers of (dedicated) Vibrating grizzly/ screening Feeders and two (2) numbers of (dedicated) crushers respectively which shall crush limestone to(-) 20mm size or to suit limestone pulverizer and system. Each stream shall have a set of Rod gates and Rack & Pinion Gates before Vibrating grizzly Feeders to permit maintenance of equipment, hoppers and chutes in one stream without affecting the operation of other stream. | Employer to clarify the requirement for having Vibrating grizzly/ screening feeder at Crusher upstream. Bidder shall not envisage any Vibrating grizzly/ screening feeder at Crusher upstream. Also bidder shall not recommend any Rod gate/ Rack & Pinion gate before Vibrating grizzly Feeders. | Technical Specifications is clear. Bidder shall comply. |
| 614. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 4.13.15 | 20 of 73 | All valves/specialities below 50 mm size in service water/dust suppression/ potable water lines should be plug type. | Bidder shall envisage Gate/ Ball valve for the same. | Technical Specifications is clear. Bidder shall comply. |

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| 615. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 4.13.19 | 20 of 73 | For dust control in limestone storage shed during stacking and handling of limestone, roof extractors, ducting and collection hopper with bag filters shall be provided. | Roof extractor shall not be envisaged. Same shall be dry type dust extraction system comprising of dust collection hoods, ducting, fans, bag filter and dust collection hopper with bag filters. | Noted. Bidder to refer amendment in this regard |
| 616. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 4.14.3 | 21 of 73 | Air conditioning system shall be furnished for control room area of main LHP control building (if applicable) and in electrical building. | Bidder shall not envisage any Control Room building for LHP.<br><br>Hence Air Conditioning system shall not be applicable for LHP Control room building as well. | Noted. |
| 617. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 1.4.0 | 58 of 73 | Feed size: (-) 250 mm, occasionally 1-2% of 400 mm size | Crusher shall be designed for feed size of (-) 250 maximum not for 400 mm limestone particle size. Employer is requested to provide the limestone particle size distribution for designing the Crusher. | Technical Specifications is clear. Bidder shall comply. |

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| 618. | SECTION-VI PART-B | SUB-SECTION-I-M6 (Limestone Handling Plant) | 1.7.0 | 58 of 73 | Limestone feeding arrangement: Through vibrating screen feeder (However the crusher shall be designed/sized considering zero passage of limestone through screen) | Bidder not envisage any Vibrating screen feeder at Crusher upstream. | Technical Specifications is clear. Bidder shall comply. |
| | SECTION-VI PART-A | SUB-SECTION-III-A5 (Limestone & Gypsum Handling Plant) | 2.01.05 | 3 of 6 | Suitable numbers of vibrating feeders in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc. | | |
| 619. | SECTION-VI PART-A | SUB-SECTION-III-A5 (Limestone & Gypsum Handling Plant) | 3.04.00 | 6 of 6 | Complete dust suppression system for control of fugitive dust in gypsum storage shed, complete with pumps, water tanks, drives, hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works. | Bidder shall envisage Dust extraction system comprising of dust collection hoods, ducting, fans, bag filter and dust collection hopper with bag filters, similar to the system proposed for Limestone handling system. | Noted. Bidder to refer amendment in this regard |

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| 620. | SECTION-VI PART-B | SUB-SECTION-I-M1 (FGD) | 7.08.06 | 29 of 51 | Coarse-screen(s) of suitable material at suction-side of the pumps shall be provided. | Bidder shall not envisage any coarse-screen/ suction strainer at Slurry pump suctions. Suction strainer shall only be provided inside the Absorber vessel to protect the Slurry recirculation pumps as per clause no. 5.06.22 mentioned in Sub-section-I M1 (FGD) under Technical Specification Section VI Part B.<br>Employer is requested to confirm on Bidders consideration. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| | SECTION-VI PART-B | SUB-SECTION-I-M1 (FGD) | 10.01.00 | 31 of 51 | Coarse-screen(s) at suction-side of these pumps shall be provided. | | |
| 621. | SECTION – VI, PART-B | SUB-SECTION-I-M1 TECHNICAL REQUIREMENTS | 4.04.00Note (b) | 11 of 51 | Although employer envisages to install highly efficient electrostatic precipitator to control particulate emission, however. Bidder shall select the Booster fan components s1uch as blades, hubs, casing etc. to encounter the high dust burden of the order of **250 mg/Nm3.** The minimum wear life of Booster fan components shall not be less than 25000 hours of operation | Bidder would like to clarify that Booster fan components shall not be exposed to high dust load in order of 250 mg/ Nm3 since the same is going to be installed at downstream of highly efficient electrostatic precipitator (ESP). Bidder shall envisage the selection of Booster fan components considering 200 mg/Nm3 dust load as per clause no. 3.01.00 men- | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | | | | | from the date of commissioning. | tioned in Sub-section-I M1 (FGD) under Technical Specification Section VI Part B. Further if Employer still insists for high dust load, then please inform the maximum duration of such extreme dust load (250 mg/Nm3) condition. | |
| 622. | SECTION – VI, PART-B | SUB SECTION-II-A9 | Table-6 | 36 of 36 | Table-6: List of drawings /Details | Bidder request Employer to furnish the detail drawings of existing pipe /cable rack near ESP control room. Bidder also request Employer to furnish the distance from "house tac" behind chimney to road in Employer marked FGD area. | Bidder to refer drawings provided at of Sub Section- II- PROJECT INFORMATION (For Various Projects) Section –VI, Part-A for pipe/cable trestle drawings.<br><br>Bidder to refer Amended GLP being issued separately. |
| 623. | SECTION – VI, PART-A | SUB-SECTION-III-A1 FGD | 5.05.00 | 5 of 9 | The gypsum slurry from each absorber shall be fed to a common primary hydrocyclone tank……. | Bidder understands that the primary hydrocyclone feed tank may or may not be required depending on the layout and so the primary hydrocyclone tank is not envisaged for all the projects. | Specification requirement is clear under the referred cl.no.5.05.00. Bidder shall comply with the specification requirements. |

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| | | | | | | Employer is requested to confirm on Bidders above clarification. | |
| 624. | SECTION – VI, PART-A | SUB-SECTION-V SALIENT DESIGN DATA | 1.00.00 | 1 OF 26 | Flue gas data for all 800 MW units: H2O content (%V/v wet) 3.958 for Design point | H2O (%v/v) for design point shall be 13.958. Employer is requested to confirm above clarification. | Bidder to refer necessary amendment in this regard. |
| 625. | SECTION – VI, PART-A | SUB-SECTION-V SALIENT DESIGN DATA | 10.07.00 | 22 of 26 | The design capacity of the equipment mentioned in the tabular column 110%/150% of the duty requirement | Bidder clarifies that, as per the tender specification the rated capacity of the lime-stone handling system from existing CHP shall be 1200 TPH up to crusher house. So Bidder understandss that the conveying system up to crusher & crushed storage shed/silo shall be designed for 1200TPH including the Crusher. However from crushed storage silo/shed to limestone day silo shall be designed for 150 TPH.<br><br>Bidder understands that the above clause of 1200 TPH is | Bidder may please refer amendment regarding crushed limestone storage shed/Silo capacity. |

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| | | | | | | only applicable if the existing CHP is used for limestone handling system.<br><br>The common crushed silo shall be designed for 7 days of the design point consumption. | |
| 626. | SECTION – VI, PART-A | SUB-SECTION-V SALIENT DESIGN DATA | 11.01.00 | 25 of 26 | The rated capacity of all gypsum handling conveyors shall be 150 TPH. | Bidder understands that, as 3x800, 2x800, 2x660, 4x250 units shall have different gypsum production capacities, Bidder envisages to design the gypsum conveyors and shed according to the unit production capacity with 10% margin rather than standardizing to design all the conveyors to 150 TPH irrespective of the unit pro- | The rated capacity of 150 MTPH of all gypsum handling conveyors is minimum specified. If gypsum production capacities is more than 150 MTPH, the gypsum conveyors and shed shall accordingly be desiged for unit production capacity with 10% margin. |

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| | | | | | | duction capacity.Employer is requested to confirm on Bidder's understanding. | |
| 627. | SECTION – VI, PART-B<br><br>SECTION – VI, PART-B | SUB-SECTION-I-M1 (FGD)<br><br>SUB-SECTION-III-A1 (FGD) | 13.03.04<br><br>7.03.00 | 34 of 51<br><br>6 of 9 | Two (2) clarified water storage tanks along with two numbers of 2x100% clarified Booster water pumps.....<br><br>One (1) clarified water storage tanks..... | Both clauses are contradictory to each other, so Employer to clarify whether to use one clarifier storage tank or two. | Bidder to refer necessary amendment in this regard. |
| 628. | SECTION – VI, PART-A | SUB SECTION-II-A1 PROJECT INFORMATION, KUDGI 3X800 MW | 7.08.00 | 23 OF 38 | Barometric Pressure: The minimum average atmospheric pressure was found to be.... | Employer to confirm the annual average barometric pressure for designing the FGD. | Specification is quite clear and the details are indicated in page no.23/38. |
| 629. | SECTION – VI, PART-A | SUB SECTION-II PROJECT INFORMATION FOR ALL PROJECTS | - | - | General Point | Bidder request Employer to provide the minimum & maximum temperature of cooling water blowdown (Process Water for FGD) and clarified water. | Please refer specification Cl no-4.02.00 (a), Sub-section -I-M5, Part-B, Section-VI for secondary water inlet temperature. Specification is quite clear in this regard. |

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| 630. | SECTION – VI, PART-A | SUB SECTION-II PROJECT INFORMATION FOR ALL PROJECTS | - | - | General Point | Bidder request to provide TDS of cooling water blow-down (Process Water for FGD) and clarified water | Bidder to refer 'Note' to design Clarified Water Analysis provided in Technical specification. The water quality of CW blow down shall accordingly be arrived by the bidder. |
| 631. | SECTION – VI, PART-B<br><br>SECTION – VI, PART-A | SUB-SECTION-I-M1 FGD<br><br>SUB-SECTION-III-A1 FGD | 7.08.02<br><br>6.02.00 | 29 OF 51<br><br>5 of 9 | The contractor shall provide **2x100%** pump to pump back the slurry from the sump back to the absorber maximum of 8 hrs.<br><br>The contractor shall provide **1x100%** slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.). | Both the clauses are contradictory each other, so Employer is requested to confirm the no. of pumps. | Bidder to refer necessary amendment in this regard. |
| 632. | SECTION-VI PART-B | SUB-SECTION-I-M1 (FGD) | 6.07.03 | 24 OF 51 | The slurry pipes shall be lined with replacable wear resistant natural rubber lining of minimum 10 mm thickness. | Bidder considered 6mm rubber lining thickness inside all ERW Carbon Steel pipe and bends/miter for DN80 size and above used for slurry handling.<br>Employer is requested to confirm on above consideration. | Bidder shall comply with the specification requirements. |

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| 633. | SECTION.VI, PART-A | SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS | 1.04.00 | 1 OF 3 | **Equipment Cooling Water**<br><br>**<u>Normal make up to ECW tank:</u>**<br>Contractor shall take a tap off suitably from the existing DM normal make up header ( **DM normal make up pump discharge**) available along C-row at CD bay rack for meeting the makeup water requirement of ECW system.<br><br>**Emergency make up to ECW tank:**<br>Contractor shall take a tap off suitably from the existing DM Emergency make up header (**condensate transfer pump discharge**) available along C-row at CD bay rack for meeting the emergency make up water requirement of ECW system. | Bidder request Employer to furnish the following details:<br><br>- Please furnish the Terminal Point coordinate of "DM normal makeup pump discharge" for connection of Normal make up ECW tank and markup this TP in the layout drawing.<br><br>- Please furnish the Terminal Point coordinate of "condensate transfer pump discharge" for connection of Emergency makeup ECW and markup this TP in the layout drawing. | As indicated in the Technical Specification, DM Normal make-up and Emergency Make up headers are available along TG Hall C-row at CD bay rack. Exact Terminal point coordinates shall be finalized during the course of detail engineering. |
| 634. | SECTION-VI, PART-A | SUB-SECTION-IV TERMINAL POINTS &EXCLUSIONS | 1.03.00 | 1 OF 3 | Auxiliary Steam System (For ZLD application) Contractor shall take a tap off suitably from the existing Aux. steam header (Pr. 16 ata, Temp-210 | Bidder request Employer to furnish the Terminal Point coordinate of "BC bay dearator floor" for connection of Auxiliary Steam Sys- | Bidder to comply specification requirements. |

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| | | | | | deg. C) availabl at **BC bay below dearator floor**. | tem (For ZLD application) and markup this TP in the layout drawing. | |
| 635. | SECTION-VI, PART-A | SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS | 1.05.00<br><br>1.06.00<br><br>1.07.00 | 2 OF 3 | **Process Water :**<br>For FGD system, Contractor shall take a tap off suitably from the existing **CW blow down header available near the CW pump house.** The pressure available at TP will be 1.9 Ksc (gauge) wrt FGL (approx. .).<br><br>**Gypsum Wash Water (Clarified Water):**<br>For Gypsum washing, Contractor shall take a tap off suitably from the **existing HVAC header (HVAC make up pump discharge)** available along C-row at CD bay rack for meeting the water requirement of Gypsum washing.<br><br>**Portable water:**<br>Contractor shall take a tap off | - Bidder request Employer to furnish the Terminal Point coordinate of "existing CW blowdown header" for connection of Process water and markup this TP in the layout drawing.<br><br>- Bidder request Employer to furnish the Terminal Point coordinate of "existing HVAC makeup pump discharge" for connection of Gypsum wash water (clarified water) and markup this TP in the layout drawing.<br><br>- Bidder request Employer to furnish the Terminal Point | Provisions of Technical Specification are clear. Bidder shall comply with the same. Further, exact terminal points shall be finalized during the course of detail engineering. |

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| | | | | | suitably from the **existing potable water supply header (potable water pump discharge**) available along C-row at CD bay rack for meeting the potable water requirement | coordinate of "existing portable water pump discharge in CD bay rack" for connection of Portable water and markup this TP in the layout drawing. | |

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| 636. | SECTION-VI, PART-A | SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS | 1.08.00 | 2 OF 3 | Waste Water<br>FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank , and 300 mm above FFL in HCSD Silo Area. Pressure at terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be <50°C. | Bidder request Employer to furnish the Terminal Point coordinate of "existing HCSD Mixing Tank in HCSD Silo Area" for terminating the waste water and markup this TP in the layout drawing. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 637. | SECTION-VI, PART-A | SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS | 1.08.00 | 2 OF 3 | FIRE DETECTION AND PROTIECTION SYSTEM<br>(i) Mechanical:<br>Separate Hydrant and spray Hader (within 100 meter) available in plant area for tapping required for Hydrant and spray system for FGD/ZLD facilities. Minimum pressure available for hydrant and spray system shall be 8 Kgf/cm2. | Bidder request Employer to furnish the Terminal Point coordinate of "existing Hydrant and spray Hader" for connection of Hydrant and markup this TP in the layout drawing. | Terminal point coordinate of existing hydrant and spray header shall be furnished during detailed engineering based on bidder's requirement. However for existing tap off point for hydrant and spray line, Bidder to refer Cl. No 1.11.00, Sub-section-IV, Part-A of technical specification, Section-VI. |
| 638. | SECTION-VI, PART-A | SUB-SECTION-VII MANDATORY SPARES | 1.12.00 | 10 OF 61 | Slurry Line Bends 4 no. of each type and size | Employer to confirm that this clause is applicable for bends used in Recycle Pump discharge & suction lines also. | Bidder's understanding is correct. Bidder shall comply with the specification requirements. |

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| 639. | SECTION-VI, PART-A | SUB SECTION-III-A1 FGD | 1.01.00 | 1 OF 9 | The contractor shall also include all supporting and structural works, like pipe trestles, platforms, staircases in their scope of work. | Bidder understands that, the pipe connections from Terminal Points to FGD area, Dewatering & ZLD area along with pipe connections between FGD area & Dewatering/ZLD area, Bidder will use Employers Pipe Trestle/Rack, then further distribution within FGD area is in Bidders scope.<br>Employer is requested to confirm on Bidders consideration. | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles. |
| 640. | SECTION-VI, PART-B | SUB-SECTION-I-MS (LOW PRESSURE PIPING) | 2.02.09 | 3 OF 16 | Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes. | Bidder has overground pipes in RC pump suction & discharge having size higher then 800 NB and there inspection holes are not being provided. So Bidder understands that this clause may be applicable for underground pipes only. Employer to confirm on Bidders understandsing. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 641. | SECTION-VI, PART-B | SUB-SECTION-I-MS (LOW PRESSURE PIPING) | 2.02.11 | 4 OF 16 | For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1 :8. Requirement shall be decided as per relevant code. | Bidder understands that this clause is not applicable for Recycle Pump suction & discharge line.<br>Employer to confirm on Bidders understanding. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 642. | SECTION-VI, PART-B | SUB-SECTION-I-M8 (LOW PRESSURE PIPING) | 2.02.08 | 3 OF 16 | For rubber lined ERW pipes, bead shall be removed. | Bidder understandss this clause is applicable for Pipe sizes DN80 and above. Employer is requested to confirm on Bidders understandsing. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 643. | SECTION-VI, PART-B | SUB-SECTION-I-M8 (LOW PRESSURE PIPING) | 2.07.02 | 7 OF 16 | For pipe size 350NB and above miter bends may be used for all pipes except rubber lined pipes. | Bidder clarifies to use miter bends with rubber lining for size above DN1200,as fittings for the same are not available in standard. Employer is requested to confirm on Bidder's understanding. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 644. | SECTION – VI, PART-A | SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM | 2.02.00 | 2 OF 8 | Single input DIN rail mounting type temperature transmitter (mounted in JB) shall be provided by the Contractor for all temperature elements under Contractor's scope. | Bidder understands that all temperature transmitter shall be provided by contractor is single input DIN rail mounted type (mounted in JB) for all temperature elements (i.e. for HT motor, package equipment and process instruments) and complying the Clause 3.05.00 (b) of Sub-Section-III-C2, Measuring Instruments, Page 11 of 34, of Technical Specification Section-VI, Part-B. | Bidder's understanding is correct. As per clause 2.02.00/ sub section IIIC/ section-VI/ Part-A , single input din rail mounted type temp transmitters (mounted in JB) shall be provided which shall meet the technical specification clause 3.05.00/ sub section-III C2/ section-VI/ Part B. |
| 645. | SECTION – VI, PART-A | SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM | 4.00.00 (d) | 5 OF 8 | d) Cables required for interfacing PLC control system with Employers DDCMIS ( both SG and BOP) located in CER shall be in bidder's scope.<br><br>Cables for connectivity of CEMS signals to Employers Unit DDCMIS located in Unit CER shall be in bidders scope. | Bidder requested to Employer to provide the tentative distance between FGD Absorber area and Employers DDCMIS CER for cable estimation purpose. | Bidder to refer clause 9.03.00, PART-A, Sub Section III-C, wherein it is mentioned that "Bidder to visit site to estimate the distance between FGD control room and Employer's CCR/CER". Accordingly, bidder to visit site to estimate the cable distance between FGD absorber and employer's DDCMIS placed in CER. |

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| 646. | SECTION – VI, PART-A | SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM | 6.03.00 | 6 OF 8 | For each equipment/drives/pumps where Local Operation is envisaged in addition to control system as mentioned in respective Mechanical Sections, Bidder to consider Local Push button station comprising following:<br>a) Start Push Button<br>b) Stop Push Button<br>c) ON Running Lamp<br>d) OFF Lamp<br>e) MCC Disturbance Indicating Lamp | Bidder did not envisage any local Push button station of equipment/drives/pumps for FGD system. Employer is requested to confirm on Bidders consideration. | Bidder's proposal is not acceptable. Bidder to refer the relevant clauses of specification where equipment/drives/pumps for which Local Operation is envisaged has been mentioned. Bidder to provide local push button stations accordingly. |
| 647. | SECTION – VI, PART-A | SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM | 6.05.00 | 6 OF 8 | The minimum quantity per unit of furniture envisaged in FGD control room is as mentioned below:<br>a) Chair-4 nos.<br>b) Printer table- 1 no<br>c) Computer table- 2 no.<br>d) Key pad- 1 no.<br>e) Locker set -1 no | Bidder understands that these furniture shall be applicable for control room wise like if 2x660 MW having one control room than these furniture shall be applicable. If there is two control room than these furniture shall be provided in double. Employer to confirm on Bidders understandsing. | Bidder's understanding is not correct.<br>It is clarified that the quantity of furniture mentioned in clause 6.05.00 a) to e) is on **per unit basis.** For example: In case of MOUDA-II (2x660MW) project, the quantity of furniture to be supplied shall be twice of the furniture quantity that is mentioned under clause 6.05.00 a) to e), Part-A, Sub Section III-C of the specification. Bidder shall comply with the specification. |

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| 648. | SECTION – VI, PART-A | SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM | 6.07.00 | 7 OF 8 | Bidder shall provide power supply distribution panels/cabinets/boxes for sub distribution of DC/Main UPS/Utility feeders on as required basis. The power supply distribution box shall include change over circuitry, switch fuse units, MCBs, terminal blocks etc. suitable for application. | Bidder understands that "change over circuitry" shall be applicable for Main UPS only. Non-UPS power shall be evenly distributed from three phase supply bus bar. 24V DC Charger shall have redundant panel. Hence, we are not envisaged "change over circuitry" in field mounted power distribution box. | Bidder's understanding is not correct.<br>Bidder to provide "changeover circuitry" in power supply distribution panels/cabinets/boxes for sub distribution of DC/Main UPS/Utility feeders on as required basis. |
| 649. | SECTION – VI, PART-A | SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM | 9.01.00 | 7 OF 8 | Contractor shall provide Remote Input Output (RIO) for PLC per unit, placed in Central Equipment Room (CER) for the same. However, contractor to consider IOs and cables for minimum number of hardwired signal exchange per unit as; follows DI - 80, DO - 80, AI - 20 and AO - 20. | Bidder envisaged that common Remote Input Output (RIO) panel shall be used for hardwired signal exchange from FGD PLC to BOP DDCMIS. FGD Common system also included in this I/O's. Employer is requested to clarify on Bidders understandsing. | Bidder's understanding is not correct.<br>Remote Input Output (RIO) panel, located in respective unit (s) CER, for hardwired signal exchange between FGD PLC and unit's BOP DDCMIS shall be provided on **per generating unit basis.** |

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| 650. | SECTION – VI, PART-A | SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM | 9.02.00 | 8 OF 8 | 4) Contractor shall provide complete logics for FGD and associated system such as booster fan blade pitch control, FGD bypass damper control, FGD inlet and outlet gate control etc. FGD OEM shall furnish recommendations, if any, for implementation in employer's DDCMIS for boiler control. | Bidder shall be submitted booster fan blade pitch control logic for "For Information" only. This logic has been provided from (typical) past projects. The plant owners (NTPC) have then used the logic to incorporate the booster fan inlet pressure control into the plant boiler furnace draft control system. Boiler/NTPC shall be revised according to the plant specific control requirements. This revision should involve an integration of ID Fan and Booster Fan draft control with many possible digital/PID loop signals to prevent draft increase/decrease , response to MFT, loss of FSSS communications, and other protections in the design. Employer/NTPC will be the owner and approver for the furnace draft control and the booster fan pressure control. | Bidder's reply is not acceptable. Bidder shall comply with the specification requirement. |

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| | | | | | | The Bidder logic is only given for a possible starting point only. | |
| 651. | SECTION – VI, PART-A | SUB-SECTION-VII, MANDATORY SPARES | Clause 1.25.00 and sub-clause 1.05.00 | 48 OF 61 | 3. Other cables - 5% of each type, pair and size of actual installed quantity. | Bidder understands that this clause is applicable for pair cable ( Cable type-F & G type for 4 pair and above only) and this clause is not applicable for Core cable. Employer is requested to clarify on Bidders understandsing. | Bidder's understanding is not correct. The clause is also applicable for core cables. Bidder shall comply with the specification requirement. |

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| 652. | SECTION – VI, PART-B | SUB-SECTION-III-C1, BASIC DESIGN CRITERIA | 4.01.00 | 3 OF 4 | For PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 Deg. C. For mini-UPS, the same shall be 40 Deg.C. | Bidder understands that main UPS (Configuration-B) is used for this project and mini-UPS(Configuration-C) is not envisaged. | Bidder's understanding is not correct. Mini UPS is envisaged for 01 (one) no. of OWS cum EWS. Input supply for mini-UPS shall be taken from UPS power distribution board. Refer amendment in this regard. |
| 653. | SECTION – VI, PART-B | SUB-SECTION-III-C1, BASIC DESIGN CRITERIA | 4.01.00 | 3 OF 4 | Instruments, devices and equipments for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired utility station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification. | Bidder understands that this clause is applicable for field mounted panels/cabinets/desks but it is not applicable for field mounted instruments. This is stated in Table that " Ambient Temperature (outside cabinets)" and " Required protection Class of panels/cabinets/desks" to be provided by contractor. | Bidder's understanding is not correct. The referred clause 4.01.00, PART-B, Sub Section-III-C1 is applicable for field mounted instruments also. |

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| 654. | SECTION – VI, PART-B | SUB-SECTION-III-C2, MEASURING INSTRUMENTS | 2.05.00 | 8 OF 34 | HART Hand Held Calibrator : Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatibility transmitter. The Hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of Hand held calibrator is not suitable for communicating with all types of transmitters then separate Hand held calibrator will be provided for that specific type of transmitter. | Bidder understands about the quantity of Hand held calibrator in this package. Bidder envisaged that two nos. Hand held calibrator shall be fulfil the requirement. Employer is requested to clarify on Bidders understandsing. | The quantity of hand held HART Calibrator shall be one number per generating unit. For example in MOUDA-II (2x660MW) project, the quantity of hand held HART calibrator shall be two (2) number.<br>Refer amendment in this regard. |
| 655. | SECTION – VI, PART-B | SUB-SECTION-III-C2, MEASURING INSTRUMENTS | 7.00.00 | 15 OF 34 | Limit Switches: Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55. | Bidder understands that the specification for limit switches stated here is applicable for all type limit switches like On/Off valves, process switches etc. Employer is requested to clarify on Bidders understandsing. | Bidder's understanding is not correct. It is clarified that Limit switches specificification is applicable for end position switches provided with Open/close type pneumatic valves/dampers, manual valves/dampers. |

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| 656. | SECTION – VI, PART-B | SUB-SECTION-III-C2, MEASURING INSTRUMENTS | 8.00.00 | 16 OF 34 | Coriolis Flow Transmitter : Viscosity range of Fluid is 0-500cst for HFO. | Bidder understands that this clause shall be applicable for density of gypsum/reagent slurry but this clause indicates the HFO (Heavy Fuel Oil). Employer is requested to clarify on Bidders understandsing. | Bidder's understanding is correct. Refer amendment in this regard. |
| 657. | SECTION – VI, PART-B | SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM | 2.02.00 | 3 OF 27 | Wherever Dual processor based PLC system has been specified, each PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. | Bidder understands that the Sub-Vendor/supplier provided PLC/control system shall be stand alone/non-redundant where working+standby machine provided (redundant machine provided). Employer is requested to clarify on Bidders understandsing. | Bidder's understanding is not correct.<br>It is clarified that all the processors shall be redundant in line with the specification requirement. However, the number of redundant processors shall depend on the number of I/Os and I/O handling capacity of the processors being provided. |
| 658. | SECTION – VI, PART-B | SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM | 9.05.00 | 19 OF 27 | The UPS Power Supply for various systems shall consist of one or more of the following configuration.<br>Bidder shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and data sheets etc. & this shall be finalised subject | UPS Configuration-B and UPS Configuration-C does not call for any redundancy criteria of UPS in the said clause. Bidder wishes to understands the redundancy criteria of UPS power supply system from Employer. | Refer amendment in this regard. |

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| | | | | | to employer's approval during details engineering. | | |
| 659. | SECTION – VI, PART-E | SCHEME FOR UNINTER-RUPTIBLE POWER SUPPLY SYSTEM-CONFIGURA-TION-B | 0000-999-POI-A-019C | SHEET 2 OF 2 | Scheme for uninterruptible power supply system-Configuration-B | This scheme does not call for UPS redundancy. Bidder wishes to understands the redundancy criteria of UPS power supply system from Employer. | Bidder's understanding is correct. Refer amended tender drg. no. 0000-999-POI-A-019C in this regard. |
| 660. | SECTION – VI, PART-E | SCHEME OF FGD-ABSORBER SYSTEM (SIN-GLE UNIT) | - 0011-109-POM-A-001 (a)<br><br>- 0011-109-POM-A-001 | | Scheme shows FI (Flow Indicator) and FT (Flow Transmitter) are installed in Booster Fan common discharge flue gas duct. | We understands that Flow Indicator (FI) is a digital display of electronic Flow Transmitter (FT). No separate Flow Indicator (FI) shall be envisaged in addition of Flow Transmitter (FT). | Bidder's proposal is acceptable. |

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| 661. | SECTION – VI, PART-E | SCHEME OF FGD-ABSORBER SYSTEM (SINGLE UNIT) | - 0011-109-POM-A-001 (a)<br><br>- 0011-109-POM-A-001 | | Schemes shows DPT with DPI across ME in Absorber. | We understands that DP Indicator (DPI) is a digital display of electronic DP Transmitter (DPT). No separate DP Indicator (DPI) shall be envisaged in addition of DP Transmitter (DPT). | Bidder's understanding is not correct. DP Indicator (DPI) shall be separately provided along with DP Transmitter (DPT). Bidder shall comply with the specification requirement. |
| 662. | SECTION – VI, PART-E | STANDARD CONFIGURATION DIAGRAM FOR PLC BASED OFFSITE CONTROL SYSTEM | 0000-151-POI-A-013 | | Standard configuration diagram for PLC based offsite control system. | Bidder understands that this scheme is applicable for FGD PLC control system in following configuration. For Example:1. 2x660 MW or 2x800 MW : One OWS+One OWS/EWS at FGD Control Room for FGD Operation.2. 3x660 MW or 3x800 MW : Two OWS+One OWS/EWS at FGD Control Room for FGD Operation.3. 4x250 MW : Three OWS+One OWS/EWS at FGD Control Room for FGD Operation.Employer is requested to clarify on Bidders understandsing. | Bidder's understanding is not correct. Bidder to refer clause 6.01.00, PART-A, Sub Section-IIIC, where in it is mentioned that Operator Work Station (OWS) shall be supplied on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). However, bidder to consider minumum quantity of OWS and OWS cum EWS as follows:<br>a) OWS (placed in FGD control |

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| | | | | | | | room)-(N+1) where N is the total number of generating units per project under this package.<br>b) OWS cum EWS (placed in FGD control room)-ONE (1)<br>c) OWS (placed in central control room of each generating unit)-TWO (2).<br>Bidder to refer amendedment in this regard. |
| 663. | SECTION – VI, PART-A | SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS | 1.13.01 | 3 of 3 | Terminals of Employers HT switchgear. | Bidder request Employer to furnish the co-ordinate / Location of Employers Existing HT switchgears / Floor / Building of each plants. | Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI).<br>Switchgear Panel is earmaked in Annexure-A. |

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| 664. | SECTION – VI, PART-A | SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT | 1.08.00 | 2 of 6 | 2) Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 0011-109-POE-J-001 on the employers nearest trestle in the FGD area as shown in Drg no 0011 -999-POC-F-001 subject to availability of space and suitability. In case of non availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection & cable laying. | Bidder understands that spare cable trays (HT & Control) available in the employers nearest trestle from Employers Existing HT Switchgear building to Proposed FGD area.<br><br>In case of non availability of spare cable tray in employer's existing trestle, Employer shall make necessary space on the nearest trestle for laying of new FGD cable trays (By Bidder) from Employers Existing HT Switchgear building to Proposed FGD area's. So Bidder not envisaged any new cable trestle for laying of necessary cables from Employers Existing HT Switchgear building to Proposed FGD area's.<br><br>Bidder request Employer to indicate the existing trestle / cable route where non availability of spare cable tray in | bidder's understanding is NOT correct. Bidder to provide cable tray and its supports for his scope of cable on employer trestle. In case of non availability of space in employers trestle, bidder to make necessary arrangements for cable tray erection and laying. refer clause no:- 1.08.00.2. However bidder may visit the project in order to get itself acquainted with existing electrical of plant |

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| | | | | | | employer's trestle (Drg no 0011 -999-POC-F-001). | |

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| 665. | SECTION – VI, PART-E | TENDER DRAWING LIST - Electrical single line diagram for FDG package | Drg No. 0011-109-POE-J-001/A-E, Rev A | General Notes-11 | Panel being used for feeding of CHP / AHP HT Transformer shall be suitably modified to DD type for feeding of 11kV FGD TIE switchgear . CHP / AHP HT Transformer shall then inturn be fed from 11kV FGD TIE switchgear. Necessary cabling upto AHP / CHP transformers shall also be in scope of Bidder. | Bidder request Employer to furnish / clarify the following points:1. Feeder details of Employers Existing HT SWGR being used for feeding of CHP / AHP HT Transformers (with Detailed drawings, i.e. GA, IGA, SLD, Schematic diagram, etc..). 2. Availability of existing cable route from Employers Existing HT Switchgear building to Proposed FGD area.3. Co-ordinate / Location of Existing 11/3.45kV CHP / AHP aux. Transformers and CHP/AHP Electrical Building.4. Rating of Existing 11/3.45kV CHP / AHP aux. Transformers (with Detailed drawings, i.e. GA, Name Plate details, Terminal Box details, etc...)5. Type and size of existing cables being used for Existing HT SWGR to 11/3.45kV CHP / AHP aux. Transformers.6. Availability of existing cable route from | Please refer Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI).<br><br>Necessary details/GA/Layout drgs regarding co-ordinates and location of Transformers/Switchgear rooms along with details of cables shall be intimated during detailed engineering.<br><br>bidder's understanding is NOT correct. Bidder to provide cable tray and its supports for his scope of cable on employer trestle. In case of non availability of space in employers trestle, bidder to make necessary arrangements for cable tray erection and laying. refer clause no:- 1.08.00.2. However bidder may visit the project in order to get itself acquainted with existing electrical of plant. |

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| | | | | | | Existing 11/3.45kV CHP / AHP aux. Transformers to Proposed FGD area.7. Existing TRF Feeder shall be modified to "DC" Type (Incomer) instead of "DD" type (Bus coupler) | |

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| 666. | SECTION – VI, PART-E | TENDER DRAWING LIST - Electrical single line diagram for FDG package | Drg No. 0011-109-POE-J-001/A-E, Rev A | General Notes-10 | Two Number 11kV Motors per Unit can be Fed from Existing spare Feeders in Station Boards (Spare feeder of MDBFP Rating and spare feeder of Largest TRF. Rating to be used as ID Booster Fans). Necessary augmentation and modification required in switchgear panels for this purpose shall be in scope of Bidder. | Bidder request Employer to furnish the following:<br><br>1. Feeder details of Employers Existing HT Station boards being to be used for feeding of Booster Fans Motors (with Detailed drawings, i.e. GA, IGA, SLD, Schematic diagram, etc..).<br><br>2. Availability of existing cable route from Employers Existing HT Station boards building to Proposed FGD area for Booster Fans. | 1. Please refer Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI).<br>2. bidder's understanding is NOT correct. Bidder to provide cable tray and its supports for his scope of cable on employer trestle. In case of non availability of space in employers trestle, bidder to make necessary arrangements for cable tray erection and laying. refer clause no:- 1.08.00.2. However bidder may visit the project in order to get itself acquainted with existing electrical of plant |
| 667. | SECTION – VI, PART-E | TENDER DRAWING LIST - Electrical single line diagram for FDG package | Drg No. 0011-109-POE-J-001/A-E, Rev A | - | Four Nos. (Two Nos. each Bus section) of spare 11 kV feeder in 11kV FGD TIE Switchgear for Owners USE. | Bidder request Employer to furnish the following regarding the spare feeders:<br>1) Rating of spare feeder<br>2) Type of spare feeders (i.e. DA / DAF / DB / DBF)<br>3) Running mode (i.e. working, standby)<br>4) Maximum expected load to fed. | Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |

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| 668. | SECTION – VI, PART-B | SUB SECTION-II-E-1 General Electrical Specification | 2.09.00 | 6 of 7 | DG set(s) shall be capable of meeting 100% of essential load requirements of FGD system including starting of the largest motor (DOL) with other load connected without exceeding the permissible starting voltage drop. | Bidder understands that DG set sizing shall be as per sub-section -II-E-11 (Diesel Generator, Cl. No. 4.04.00, Pg. 3 of 19)<br><br>Employer is requested to confirm on Bidders above clarification. | Bidder understanding is correct. However bidder shall also comply to the requirements of clause no:- 2.09.00 |
| | SECTION – VI, PART-B | SUB SECTION-II-E-11 Diesel Generators | 4.04.00 | 3 of 19 | The DG set shall be capable of starting largest connected motor with terminal voltage drop being restricted to 15%. Generator loading before starting of this motor shall be considered as 50% of generator rating | | |
| 669. | SECTION – VI, PART-B | SUB SECTION-II-E-9 HT SWITCHGEAR | 1.00.00 | 2 of 39 | All MV Switchboards is provided with one spare motor feeder and one transformer feeder on each section for future requirements. | Bidder understands that spare motor & transformer feeder shall be consider in the SWGR if the motor & transformer feeder is applicable for that switchgear. (for example, IN 3.3kV switchgear Bidder don't have any transformer feeder, then Bidder will not consider any spare transformer feeder in this switchgear). Employer is | This clause is deleted. Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |

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| | | | | | | requested to clarify the same. | |
| 670. | SECTION – VI, PART-B | SUB SECTION-II-E-10 LT SWITCHGEARS & LT BUSDUCTS | 1.01.01 | 1 of 58 | f) ESP consumption for 100% BMCR operation shall be considered and further this load shall be uniformly divided among ESP Switchgear | This clause is not applicable to this project. Employer is requested to confirm the same. | Confirmed. |
| 671. | SECTION – VI, PART-B | SUB SECTION-II-E-10 LT SWITCHGEARS & LT BUSDUCTS | 1.01.01 | 1 of 58 | h)) The sizing of Unit Emergency boards shall be in according to the DG rating. The Emergency board shall have tie to both sections of unit Service Switchgear for catering unit loads in Blackout Conditions. | Bidder understands that one no. common DG sets along with Emergency Switchgear shall be considered for the common system loads & unit specific system loads. Emergency Switchgear shall feed to unit Emergency boards as per process unit Emergency load requirements. And the sizing of Unit Emergency boards shall be as per process unit Emergency load requirements. Employer is | Supply of FGD Emergency MCC shall be as per slected DG ratings. |

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| | | | | | | requested to clarify the same. | |
| 672. | SECTION – VI, PART-B | SUB SECTION-II-E-10 LT SWITCHGEARS & LT BUSDUCTS | 1.03.00 | 2 of 58 | All LV Switchboard shall be provided with spare feeders / modules as specified in relevant clause of Part-A of Technical Specification. | Bidder did not found the details of spare feeders / modules requirement in Part-A of Technical Specification. Employer is requested to furnish the same. | This clause is deleted. Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |
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| 674. | SECTION – VI, PART-A | sub Section-III , Electrical system / Equipment | 1.12.00 | 4 of 6 | Construction power : To meet the construction power requirement of the FGD and associate system the Employer shall provide 2 nos 415 feeder in LT switch gear . The contractor shall extend supply from these construction power fedders to meet the construction power requirement..... | Bidder request Employer to furnish the following inputs / clarifications:<br><br>a) Bidder request Employer to provide the electricity per unit charges to estimate the electricity cost for construction power.<br><br>b) Bidder request owner to provide the distance / route of cable from LT SWGR to work site.<br><br>c) Bidder also understands that the power for Testing & Commissioning shall be provided at free of cost | a)Electricity charges shall be as prevalent rate of DISCOM.Refer subsection-IIIB,part-A,Construction power.<br>b)Location of construction power feeders shall be provided during detail engineering.<br>c)Bidder's understanding is correct. |
| 675. | SECTION – VI, PART-D | Erection Condition of contract | 27.00.02 | 11 0f 53 | Water : Contractor shall make all arrangement himself for the supply of construction water as well as portable water for labour and other personnal at work site/colony . However drawl of construction and portable water from borewell shall be permitted..... | Bidder request Employer to furnish the following inputs / clarifications:<br><br>a) Bidder request Employer to provide contraction water at free of cost<br><br>b) Bidder understands that | a)<br>Specification requirement is clear at cl.no. 27.00.02. Bidder shall comply with the specification requirements.<br><br>b) |

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| | | | | | | Employer shall provide limestone, lime, water, compressed air etc. for Testing and commissioning at free of cost. | Except Limestone which will be provided by Employer, Bidder to arrange for other necessary things required for Testing and commissioning. |
| 676. | SECTION – VI, PART-D | Erection Condition of contract | 28.05.02 | 12 of 53 | First Aid - The Employer will provide the contractor , in case of any emergency ----- | Bidder requested Employer to provide the First Aid facilities in existing plant Hospital/dispensaries also along with Ambulance services if required. | In case of emergency, the Employer will try to provide the facility in existing plant hospital/dispensaries if available. |
| 677. | SECTION – VI, PART-D | Erection Condition of contract | 36.05.00 - F | 19 of 53 | Proper lighting of all the construction / erection area-------- | a) Bidder understands Proper lighting shall be done by Bidder for its scope of work & the designated construction area only.<br>b) As Employer supplying the construction Power from 2nos of 415 V LT feeder, bidder understands that the construction of power ring main is not in the scope of Bidder. | a. Bidder's understanding is correct.<br><br>b. Bidder's understanding is correct. |

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| 678. | SECTION – VI, PART-D | Erection Condition of contract | 44.22.00 | 33 of 53 | Hydra shall not be used for material transport | Bidder understandsing is that Farna shall be used in place of Hydra. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 679. | SECTION – VI, PART-A | Scope of supply and Services | 2.00.00 ( 10) | 3 of 4 | Providing all necessary fire fighting devices/ Equipment/Fire tender etc. required during the project execution…… | Bidder shall provide all fire fighting devices / Equipment during the entire Project Execution period for its scope of work. However Bidder requested Employer to provide the Fire Tender of the existing Plant during emergency if required | Bidders understanding/request is not correct. |
| 680. | SECTION – VI, PART-B | SUB-SECTION-VI-D Civil Works | 4.01.00 | 18 of 69 | Drainage System | Bidder clarifies that Employers existing drain invert level shall be necessary to plan the RCC drain(in the scope of Bidder) on which water from the pit in FGD area shall be diverted. So Bidder request Employer furnish the above information. | Refer General Layout Plan. Road and drain drawing shall be provided after award. |
| 681. | SECTION – VI, PART-A | SUB-SECTION-II-A2-Project Information-Lara-I 2X800 MW | Annexure-II | 23 to 39 of 48 | Borelog Data Sheet | The Location and Co-ordinates of various borelogs marked in the data sheet does not match with the location indicated in GLP. | Bidder may refer Clause No.7.00.02, as mentioned in Clause No. 7.00.02, the available borelog data is of vicinity to proposed structure and the |

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| | | | | | | So Bidder request Employer to furnish the corrected documents. | same has already been furnished in the tender document. Detailed Geotechnical Investigation shall be carried out by contractor. |
| 682. | SECTION – VI, PART-A | SUB-SECTION-II-A4-Project Information-Darlipalli-I 2X800 MW | - | - | Borelog Data | No borelog data is available in the tender. Bidder request Employer to furnish the nearest vicinity borelogs if not available for FGD area. | Bidder to refer necessary amendment in this regard. |
| 683. | SECTION – VI, PART-A | SUB-SECTION-II-A6-Project Information-Solapur-II 2X800 MW | - | - | Borelog Data | No borelog data is available in the tender. Bidder request Employer to furnish the nearest vicinity borelogs if not available for FGD area. | Bidder to refer necessary amendment in this regard. |
| 684. | SECTION – VI, PART-A | SUB-SECTION-II-A6-Project Information-Solapur-II 2X800 MW | Annexure-III Soil Data and Foundation System | 20 of 31 | Net Allowable Bearing Pressure | Bidder understands that in case of soil for depths greater than 1.5m, net allowable bearing pressure value available as per detailed geotechnical investigation during that stage can be utilised for foundation design. Employer is requested to confirm on Bidders understandsing. | Bidder to refer necessary amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 685. | SECTION – VI, PART-A | SUB-SECTION-III-A6 ZLD | 1.01.00 | 1 of 3 | Pre treatment system shall consist of FGD waste water storage tank (2x50%) to store FGD waste water, GGH washing water, etc. | Bidder proposes 1x100% tank sized for 30 m3/h inflow (Barh-I) and 20 m3/h inflow (Nabinagar) instead of 2x50% tanks. Please confirm. | Stipulation of technical specification is clear. Bidder to comply with technical specification requirements. |
| 686. | SECTION – VI, PART-A | SUB-SECTION-III-A6 ZLD | 1.02.00 | 1 of 3 | Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system. | We propose 1x100% Evaporative Concentration System. | Stipulation of technical specification is clear. Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system. |
| 687. | SECTION – VI, PART-A | SUB-SECTION-IV Terminal Points & Exclusions | 1.08.00 | 2 of 3 | FGD waste water pipes shall terminate along with isolation valve at 5 meters near HCSD mixing tank | Please confirm the terminal points along for outlet of the ZLD system- Water and Solids respectively | Stipulation of technical specification is clear. Bidder to comply with technical specification requirements. |
| 688. | SECTION – VI, PART-A | SUB-SECTION-IV Functional Guarantees & LD | 4.02.00 | 18 of 24 | Waste Water: The contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10 m3/h averaged over a 24 hour period for each unit. | Please clarify the exact flow rate to be considered for designing the ZLD considering 3x660 MW Barh plant and 4x250 MW BRBCL Nabinagar plant. | Bidder to refer necessary amendment in this regard. |
| 689. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 2.00.00 | 3 of 32 | Conditions of Service - 'All Design Pressure of all device, piping, and auxiliary facilities...Device and tank maximum allowance: operating pressure x 1.5' and also ' pip- | This may not apply for larger "fit for service" equipment like Evaporators and Crystallizers. We will provide our recommendations on design pressures for piping and | Technical specification requirement is clear. However, for evaporator & Crystallizer, proven design and experience meeting provenness criteria specified in tender is acceptable . |

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | ing and auxiliary facilities: 150 lb class flange, STD wall pipe' | tanks in our offer based on our proven experience. Please confirm | |
| 690. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | E 2 | 9 of 32 | Evaporative concentrator shall be designed to start / stop every day | Please clarify why this requirement is made. We presume FGD & ZLD will operate continuously. | Bidder shall comply Technical specification requirement. |
| 691. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | E 6 | 9 of 32 | Pressure vessel in evaporative concentration shall be designed as per ASME Sec VIII or equivalent code listed above. | Kindly confirm that the design shall be as per ASME Sec VIII. & no other stamping and manufacturing requirements shall be applicable. | Bidder shall comply Technical specification requirement. |
| 692. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | E 15 | 10 of 32 | Vessel support shall be designed same as materials for vessel. Different material cannot be welded to vessel. | It is common practice to provide dissimilar materials for vessel supports. Bidder requests Owner to approve as per proven practice | Bidder shall comply Technical specification requirement. |
| 693. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | F 2 | 10 of 32 | Centrifuge to dehydrate solids form evaporative concentration shall be consist of Centrifuge 2x50% | Centrifuge does not 'dehydrate solids' it makes wet cake or solids suitable for landfill. | Vessel support arrangement as per proven practice of OEM is also acceptable which shall be finalized during detail engineering. |
| 694. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 22 d | 14 of 32 | Size: 1/2%-inchOD minimum | Our minimum is 1/4" OD tube. Kindly accept. | Bidder shall comply Technical specification requirement. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 695. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 3.02.01 4) | 15 of 32 | ...the contractor shall provide duplicate pumps (2x100%) or multiple standby pumps for the same service. | Duplicate pumps are not needed for all pumps. We will propose in our offer the applicable connected redundancies and store standbys. | This shall be finalized during detail engineering. |
| 696. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 3.02.03 2) | 20 of 32 | Slurry tanks shall be provided with screen at the inlet nozzles. | This is not our practice. Screens if required will be provided to protect downstream equipment (such as heat exchangers) as per our proven experience. | Electrically driven lube oil pumps as per the proven practice of OEM is also acceptable which shall be decided during detailed engineering. |
| 697. | SECTION – VI, PART-B | SUB-SECTION-I-M7 ZLD | 3.02.05 6) | 20 of 32 | Additional required equipment for Vapour Compressor : i) Shaft driven lube oil pump | Kindly accept electrically driven lube oil pump due to limitations in design of certain compressor manufacturers | As mentioned in Cl. No. 2.00.00 D, Sub-section I-M7, Part-B, Auxiliary steam if required shall be provided by owner for start-up condition only. For continuous duty, Bidder to design the various systems considering power driven equipment and the same shall be considered in power guarantee. |
| 698. | Process Flow Diagram | ZLD | | 3 of 3 | General Point | The scheme shows steam driven crystallizer, whereas write up calls for MVR. Please clarify. | Stipulation of technical specification is clear. Biider to comply with technical specification requirements. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 699. | SECTION – VI, PART-B | SUB-SECTION - I-M7, Zero liquid discharge system | G)3 | 11 of 32 | Contractor shall provide the piping associated with unloading pump, injection tank and connection flange to connect the chemical transport vehicles | Bidder understands that their (Bidders) battery limit starts from connection flange to connect the chemical transport vehicles. From chemical vehicles chemicals will be transported to Chemical storage tanks, then dissolving tank. From chemical dissolving tank chemicals will be sent to injection tank. Employer to confirm on Bidders understandsing and Employer is requested to put these points in the Terminal Point & Exclusion chapter of Part-A, Section-VIFurther Employer to clarify the distance of chemical vehicles from chemical storage tank. | |

| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| 700. | Section - VI, Part - A | Sub Section - I | 8 of 19 | 4.01.02 | In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 4.01.01 (a) above but is a manufacturer of such equipment for units of at least 500 MW rating, the Bidder or the proposed sub vendor can manufacture such equipment for 660 MW units also. | In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 4.01.01 (a) above but is a manufacturer of such equipment for units of at least 500 MW rating, the Bidder or the proposed sub vendor can manufacture such equipment for 800 MW units also. | Bidder to refer clarifications being issued separately. |
| 701. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 4 of 9 | 5.01.00 | The employer envisages a common gypsum dewatering system for all the units. | We understand that Bidder scope included common gypsum dewatering system upto gypsum discharge from vacuum belt filter to Employers conveyor. Please clarify the scope. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 702. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 5 of 9 | 5.04.00 | 2x100% pump shall be provided to supply wash water (for cake washing as well as belt cloth washing) to the belt filters. | Since the water collected in the filterate tank from various source/equipment is an contominated water, hence the same can not be used for Cake washing, for cake washing only clarified water will be used. Please check and comfirm. | Bidder's understanding is correct. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| 703. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 5 of 9 | 7.00.00 | PROCESS WATER & COOLING WATER STORAGE & PUMPING SCHEME (FOR 2X800 MW) | In the reference clause process and cooling water requirement is specified only for 2x800 MW plants only, where as there is 3x800 MW of Kudgi-I, 2x660 MW of Mouda-II, Solapur-II, Tanda-II & Meja-I, 3x660 MW of Nabinagar - I & Barh-I and 4x250 MW of Nabinagar is also there. Hence we understand that the Process & Cooling water storage and pumping system described in rererence clause is common for all the plants. In that case bidder to consider One (1) No. process water along with 2x100% process water pump and 2x100% Mist Eliminator wash water pump for each unit.<br><br>In additon to above bidder to consider 2x100% Booster water pump comon for each plant to pump the process water from Emploeyr's terminal point. Kindly confirm. | Specification requirement is clear. |
| 704. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 6 of 9 | 7.01.01 | 2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of | Pleae note that in the Flow Diagram Dwg No. 0011-109-POM-A-003, Rev. A, only One (1) No. of Process water pump is indicated for each process water tank (i.e. total Two (2) no. of process water tank for complete plant), but in the reference clause Two (2) Nos process water pumps are specified for each process water tank. Please clarify the | Specification requirement is clear. |

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| | | | | | one unit. | discrepancy. | |
| 705. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 6 of 9 | 7.02.00 | 2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. | Pleae note that in the Flow Diagram Dwg No. 0011-109-POM-A-003, Rev. A, only One (1) No. of Mist Eliminator wash water pump is indicated for each process water tank (i.e. total Two (2) no. of Mist Eliminator wash water pump for complete FGD sysetem), but in the reference clause Two (2) Nos Mist Eliminator wash water pumps are specified for each process water tank. Please clarify the discrepancy. | Specification requirement is clear. |
| 706. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 9 of 9 | 25.00.05 | A common Nickel based alloy material storage/neutralizing tank for the both the units of storage capacity of 12 hrs of stack condensate of both the stack shall be provided. | In case of Three (3) or Four (4) Units ?. Howmany neutralising tanks to be considered. Please clarify. | Bidder to refer necessary amendment in this regard. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| 707. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 9 of 9 | 25.00.05 | A common Nickel based alloy material storage/neutralizing tank for the both the units of storage capacity of 12 hrs of stack condensate of both the stack shall be provided. | Please confirm that for each plant bidder to consider only one (1) Common storage/ neutralizing tank. No Standy tank is required. | Bidder to refer necessary amendment in this regard. |
| 708. | SECTION – VI, PART-A | SUB SECTION-III-A1 | 9 of 9 | 25.00.05 | Storage tank/neutralization tank shall be complete with dosing, mixing and preparation system. | Please clarify the dosing/neutralization system to be considered by bidder. Also please clarify the criteria/limitations for discharging stack condensate after neutralization in common drain system.<br>Also please clarify the co-ordination point of common drain system. | Bidder to refer necessary amendment in this regard. |
| 709. | SECTION – VI, PART-A | SUB SECTION-III-A2 - AC, Centilation and Compressoed air system | 3 of 4 | 3.00.00 | Compressed Air System | Please clarify the location of Instrument air and Service air compressor to be considererd by bidder. | The location of instrument air and service air compressor shall be finalized during detailed engineering while considering the bidder requiremnts. |
| 710. | SECTION – VI, PART-A | | 3 of 4 | 3.00.00 | a) Two (2) numbers (1 working+ 1 standby) oil free, rotary screw type air compressors for Instrument air and service air applications for FGD and ZLD plant (if provided) each of adequate capacity & adequate pressure, | Please clarify whether the compressor quantity (i.e. 2 Nos) specified is common for all unit of plant or for each unit. | Compressor quantity is common for all unit of plant i.e, provided on station basis. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| 711. | SECTION – VI, PART-A | Sub Section: III-A4 Equipment Cooling Water System | 1 OF 3 | 1.01.00 | (a) One cold water header tapped from CW Blowdown from CW pump discharge pipe. | Please furnish the water quantity available at cooling water discharge pipe. Also please furnish the Water analysis details. | Bidder may please refer annexure-II, page no 16 of 16, Sub section-I-M5 for available water quantity. |
| 712. | SECTION-VI, PART-A | SUB-SECTION-IV, Terminal Points and Exclusions | 2 of 3 | 1.05.00 | For FGD system, Contractor shall take a tap off suitably from the existing CW blow down header available near the CW pump house. The pressure available at TP will be 1.9 Ksc (gauge) wrt FGL (approx..). | | Bidder to refer Design water analysis provided in the Technical specification. |
| 713. | SECTION – VI, PART-A | Sub Section: III-A4 Equipment Cooling Water System | 1 OF 3 | 1.01.00 | (e) 5 x 33.33% ( 3 Working + 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives.<br>(f) 4 x 33.33% ( 3 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives. | Please clarify whether bidder to consider any Margin on Flow and Friction loss to be considered by bidder while sizing the specified pumps. | Bidder may please refer clause no 4.00.00 sizing/ design criteria, part-B, Sub section I-M5 for pump sizing.<br><br>Bidder may please refer scope of supply and services indicated on Page 3 of 3, |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
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| 714. | | | | | Equipment Cooling Water System | Please note that Equipment cooling water system for 2X660 MW Solapur-II is not specified in the specification. Please clarify whether NTPC is providing Equipment Cooling Water. If yes, please furnish the quantity, pressure and temperature availability at terminal points and terminal point. | Sub Section IIIA-04 for Solapur, scope of supply and services..<br><br>For quantity of cooling water Bidder may please refer annexure-II, page no 16 of 16,Sub section-I-M5 for available water quantity.<br><br>Terminal pressure available at TP will be 1.9 Ksc (Gauge)wrt FGL (Approx). May please refer clause no 1.05.00, page 2 of 3 of sub section IV, Terminal point and exclusion.<br><br>Temperature at terminal point will be "Not less than 36 Deg C", bidder may refer clause no 4.02.00 a). of sub section I-M5 page no 7 of 16 |

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| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| 715. | SECTION – VI, PART-A | SUB-SECTION-III-A5 Lime-stone & Gypsum Handlig Plants | 2 of 6 | 2.01.00 | Limestone Handling Plant (LHP) | Please furnish the Flow diagram for Lime Handling Plant to enable us to understand the requirement and Furnish the same. | Space available for FGD and associated system is marked in the General Lay-out Plan drawings attached with the Technical Specifi-cations. Bidder has to pro-pose the layout and Lime-stone Flow Diagram for LHP & GHP to cater the re-quirement of FGD plant based on the layout of FGD system and existing facili-ties. |
| 716. | SECTION – VI, PART-A | SUB-SECTION-III-A5 Lime-stone & Gypsum Handlig Plants | 2 of 6 | 2.01.01 | Two (2) numbers Box Feeders/ Bulk material Receiving Unit/ Un-derground Truck Unloading Hop-per / Surface feeder | Please clarify whether bidder to consider any minimum storage cacacity of Box Feeders/ Bulk material Receiving Unit/ Un-derground Truck Unloading Hopper / Sur-face feeder. | Bidder may refer Amend-ment to the subject clause for clarity in this regard. |
| 717. | SECTION – VI, PART-A | SUB-SECTION-III-A5 Lime-stone & Gypsum Handlig | 3 of 6 | 2.01.08 | Junction towers (along with un-derground / over ground RCC structures), | We request you kindly accept Steel struc-tures for overground steel structures and also junction towers. | Technical Specifications is clear. Bidder shall comply. |

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| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
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| | | Plants | | | | | |
| 718. | SECTION – VI, PART-A | SUB-SECTION-III-A5 Lime-stone & Gypsum Handlig Plants | 5 of 6 | 2.01.28 | Minimum one (1) no. Weighing Bridge for Road trucks / Tipplers shall be provided each in Lime-stone unloading area and in Gyp-sum Loading area. | Please furnish the type and capacity of weigh bridge to be considered by bidder. | Weigh bridge capacity shall be 100 MT. |
| 719. | SEC-TION-VI, PART-A | SUB SEC-TION-III-A6, ZLD | 1 OF 3 | 1.01.00 | Pre-treatment system shall con-sist of FGD waste water storage tank (2x50%) to store FGD wastewater, GGH washing water etc., | Please note that GGH is not applicable for the proposed FGD system. Hence the same will not considered for ZLD design. Kinldy confir. | Bidders understanding is correct. NO GGH envisaged. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
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| 720. | SECTION-VI, PART-A | SUB-SECTION-IV, Terminal Points and Exclusions | 1 of 3 | 1.04.01 | Contractor shall take a tap off suitably from the existing DM normal make up header (DM normal make up pump discharge) available along C-row at CD bay rack for meeting the makeup water requirement of ECW system. The pressure available at TP will be 4Ksc (gauge) wrt FGL (approx.). | Please furnish the water quantity available at Employer's Terminal point. Also please furnish the Water analysis details. | ECW (primary circuit) is a closed system and only DM water make up will be provided. Quantity for the same will be arrived upon during detail engg..<br><br>Bidder to refer Design water analysis provided in the Technical specification. |
| 721. | SECTION-VI, PART-A | SUB-SECTION-IV, Terminal Points and Exclusions | 2 of 3 | 1.04.02 | Contractor shall take a tap off suitably from the existing DM Emergency make up header (condensate transfer pump discharge) available along C-row at CD bay rack for meeting the emergency make up water requirement of ECW system. The pressure available at TP will be 4 Ksc (gauge) wrt FGL (approx.). | Please furnish the water quantity available at Employer's Terminal point. Also please furnish the Water analysis details. | ECW (primary circuit) is a closed system and only DM water make up will be provided. Quantity for the same will be arrived upon during detail engg..<br><br>Bidder to refer Design water analysis provided in the Technical specification. |

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| 722. | SECTION-VI, PART-A | SUB-SECTION-IV, Terminal Points and Exclusions | 2 of 3 | 1.06.00 | For Gypsum washing, Contractor shall take a tap off suitably from the existing HVAC header (HVAC make up pump discharge) available along C-row at CD bay rack for meeting the water requirement of Gypsum washing. The pressure available at TP will be 4Ksc (gauge) wrt FGL (approx.). | Please furnish the water quantity available at Employer's Terminal point. Also please furnish the Water analysis details. | Water quantity available at Employer's terminal point is 20m³/h. Bidder may please refer amendment.<br><br>Bidder to refer Design water analysis provided in the Technical specification. |
| 723. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data | 1 of 26 | 1.00.00 (For various 800 MW Plant) | Flue gas Compostion at FGD System Inlet (Design Point) | Please note that the total flue gas composition specified for Design Point in the reference clause is less than <100% and moisture ($H_2O$)-3.958% indicated appears to be on low side. Please check and confirm. | Refer necessary amendment in this regard. |
| 724. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data | 1 of 26, 3 of 26 5 of 26 and 7 of 26 | 1.00.00, 2.00.00, 3.00.00 and 4.00.00 | Nox: < 100mg/$Nm^3$ at 6% $O_2$ | Please clarify wet or dry | The value indicated is at 6% O2 (dry). |
| 725. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data | 1 of 26, 3 of 26 5 of 26 and 7 of 26 | 1.00.00, 2.00.00, 3.00.00 and 4.00.00 | ix) $SO_3$ (PPM) | Please clarify whether the $SO_3$ indicated in reference clause are at dry condition (or) Wet condition.<br>Also please calrify whether the $SO_3$ value indicated are at actual $O_2$ or at 6% $O_2$ | The value indicated are at actual $O_2$ at Wet condition. Bidder shall comply with the requirements of the technical specification. |

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| 726. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data | 1 of 26, 3 of 26 5 of 26 and 7 of 26 | 1.00.00, 2.00.00, 3.00.00 and 4.00.00 | x) HCl (PPM) Wet = 45 (in Both guarantee point and Design point0 | Please note that the HCl value indicated for various projects are seems very high. We request you to kindly check and confirm. Further please clarify the value indiated at actual $O_2$ or at 6% $O_2$. | The value indicated are at actual $O_2$. Bidder shall comply with the requirements of the technical specification. |
| 727. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data | 1 of 26, 3 of 26 5 of 26 and 7 of 26 | 1.00.00, 2.00.00, 3.00.00 and 4.00.00 | x) HF (PPM) Wet = 12 (in Both guarantee point and Design point0 | Please note that the HF value indicated for various projects are seems very high. We request you to kindly check and confirm. Further please clarify the value indiated at actual O2 or at 6% O2. | The value indicated are at actual $O_2$. Bidder shall comply with the requirements of the technical specification. |
| 728. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data | 3 of 26 and 5 of 26 | 2.00.00 3.00.00 | Meja - I 2X660 MW | It may please be note that in Salient Design Data the Flue gas parameters for 2x660 MW Meja - I are specified in two different clauses. Please clarify the discrepancy. | Refer necessary amendment in this regard. |
| 729. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data & Sizing | 2 of 26, 3 of 26 5 of 26 and 7 of 26 | 2.00.00 3.00.00 | Viii) Dust ($mg/Nm^3$) - 200 at design point | It may please be noted that the flue gas dust of 200 $mg/NM^3$ specified in reference cluase seems very high. Kindly once again check and confirm. Further please clarify the value indiated at actual O2 or at 6% O2. | The value indicated is at 6% O2 (dry). Bidder shall comply with the requirements of the technical specification. |

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|---|---|---|---|---|---|---|---|
| 730. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data & Sizing | 8 of 26 | 5.01.00 | The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired, for the complete load range of operation and the expected numbers of Steam Generator start-ups while designing the Chimney flue liner considering Steam Generator in operation both with & without FGD system in operation. | Please note that while the FGD system is bypassed the flue gases from SG will be evacuated through the existing stack. Wet chimney will be used only when the FGD system is in operation. Hence, stack need not be designed for the consitioned mentioned in the referred clause. Please check and confirm. | Noted. |
| 731. | SECTION-VI, PART-A | SUB-SECTION-V, Salient Design Data & Sizing | 25 of 26 | 11.01.00 | The rated capacity of all gypsum handling conveyors shall be 150TPH. | Please note that since the Gypsum handling/Conveying system is an continuous operating system, Gypsum handling conveyor capacity (150 TPH) indicated seems very High. The Gypsum handling conveyor will be designed based on the gypsum discharging from the Vacuum Belt Filter outlet. Kindly confrim. | Technical Specifications is clear. Bidder shall comply. |
| 732. | SECTION-VI, PART-A | SUB-SECTION-VI Functional Guarantees & Liquidated Dam- | 20 of 24 | 5.00.00 | AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT | Shop test or at site ? | Bidder shall note that for the AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT, test and measurements will be done at site. |

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| | | ages | | | | | |
| 733. | SECTION-VI, PART-A | SUB-SECTION-VII Mandatory Spares | 11 of 61 | 1.18.00 | Goods Cum Passenger Elevator | Please note that the Mandatory spares for Elevators are specified in two (2) Different clauses. Please clarify the requirement of spares for Elevator in Lime & Gypsum Handling System specified under Cl. No. 1.24.00. In the the technical specification Goods Cum Passenger Elevator are specified for Lime Handling and Absorber area. | Technical specification is clear. Bidder to follow Cl.1.24.00 of Sub-section VII, Section VI, Part A of the technical specifications for elavator for Limestone Handling Plant. |
| | | | 42 of 61 | 1.24.00 | Limestone & Gypsum Handling (R) Elevator | | |
| 734. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 2 of 51 | 1.03.02 | Motorized Guillotine type gates has be provided at (i) hot gas inlet to Booster Fans, (ii) Outlet of Booster Fans and (iii) in the by-pass duct (common Flue Gas Duct going towards the existing Chimney). | Please note that in the Flow Diagram {Dwg No. 011-109-POM-A-001 and Dwg No. 011-109-POM-A-001(a)} each Motorized Guillotine type gates are indicated with 2x100% seal air fans, but in the reference clause the seal air fan is specified only for Bi-plane type dampers. Please clarify whether bid- | Bidder shall comply with tender drawing and provide Guillotine type gates with 2x100% seal air fans.<br><br>Bidder to refer necessary amendment in this regard. |

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| | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 7 of 51 | 3.03.08 | The Guillotine gate type dampers mentioned at Clause No. 3.03.01 above shall have a guaranteed gas tightness efficiency (on flow) of not less than 99.95% along the duct as well as from the duct to atmosphere or from atmosphere …….. The bypass damper shall have a guaranteed gas tightness efficiency (on flow) of not less than 99.5% and 100% leak tight with seal air fans under operation. | der to consider the Seal air fans for Bi-plane type dampers only or for both Bi-plane type and Guillotine type dampers. | |
| 735. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 5 of 51 | 2.00.00 | The complete installation of liners shall be made under the supervision of the liner supplier as per their guidelines | Liner material manufacturers do not undertake the responsibility of supervision of application/ execution. We can follow manufacturers guide lines for application. Please check and confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 6 of 51 | 3.02.05 | Bidder to note that application of lining material in the duct shall be carried out under supervision of Designer/ Manufacturer. | | |
| 736. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 8 of 51 and 10 of 51 | 4.01.01 (3) (i) and 4.02.00 (ii) | (ii) Flue gas flow through each fan | It may please be note that the Flue gas flow rate in the reference clause are not matching with the Flue gas data mention in salient design data and Sizing. Please calrify the descripency. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 737. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 10 of 51 | 4.02.00 | (iii) Margin over flow - 20% | Please calrify whether bidder to consider the margin overflow on Guarateed Flue gas flow rate or Design Flue gas flow rate. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 738. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 10 of 51 | 4.02.00 | (iv) Margin over pressure requirement - 44% over the calculated value | Please confrim that bidder to consider margin over pressure requirement of 44% over the calculated value i.e. on the actual flue gas flow rate (Without any margin on flue gas flow rate) | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 739. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 12 of 51 | 4.07.00 | (b) Fan control system - ii) The final control element shall not have any backlash, plays etc., and shall operate in the range of 20% to 80% depending upon generating loads upto Boiler MCR | Please furnish the BMCR load data. The same is not attached with the specification. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 740. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 14 of 51 | 5.01.00 | (iii) The slurry recirculation pumps shall have a minimum margin of 10% on flow and 10% on frictional head, over the actual requirement for meeting the guarantee and design point conditions. | Kindly note that our technology partner do not recommend any margin on the flow and head as this will affect mass balance. Please check requirement. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 741. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 14 of 51 | 5.01.00 | V) Minimum 10% spare nozzles shall be provided at each level. | It may please note that 10% of spare nozzles for each spray level is not applicable for our design. Hence please confirm that the same shall be as per Bidder's design | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | | | | | | standard. | |
| 742. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 16 of 51 | 5.03.03 | Oxidation nozzles / spargers shall have a minimum redundancy of 10% or as per the contractor's proven practice whichever is maximum. | Please note that we are supplying lance type oxidation air system (one (1) lance for each agitator) 10% margin on oxidation air nozzle is not applicable for our design. Hence please confirm that the margin for oxidation nozzles will be applicable as per bidder design standard. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 743. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 25 of 51 | 7.03.01 | Each set of primary dewatering hydro cyclone shall be sized to dewater the gypsum slurry produced **by the unit** operating at Design point with an additional 10% margin. | Please confirm that primary hydrocyclone is common for all the units the same shall be sized to dewater the gypsum slurry produced by **all the units** operating at design conditions. | Bidder's understanding is correct. Refer necessary amendment in this regard. |
| 744. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 25 of 51 | 7.04.01 | Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum: | Please note that the solid concentration of gypsump underflow from Primary Hydrocyclone (i.e. inflow to the Vacuum belt filter) will be 50% as per our design standard. Kindly confrim. | NTPC noted. Will be discussed during detail engg.. |

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| 745. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 29 of 51 | 7.08.02 | The contractor shall provide 2 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours. | Please note that slurry pump quantities are different in the referred clauses. Please check and clarify. | Bidder to refer necessary amendment in this regard. |
| | SECTION – VI, PART-A | SUB SECTION-III-A1 | 5 of 9 | 6.02.00 | The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.). | | |
| 746. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 30 of 51 | 8.04.00 | All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized valves shall be provided for each pump for automatic flushing of the pump after each shut down. | Please note that in the Flow Diagram {Dwg No. 011-109-POM-A-001 and Dwg No. 011-109-POM-A-001(a)} Pneumatic operated valves are indicated for Flushing water line but in the reference clause Motor operated valves are specified. Please clarify the descripency. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 747. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 16 of 51 | 5.03.04 | The oxidation system shall be complete with a quenching system to cool down heated oxidation air in order to prevent any scaling or buildup that could occur at the sparger tips due to localized evaporation of recycled slurry. | We are providing lance type oxidation systen which do not require quenching system for oxidation air. Please review and confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 748. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 16 of 51 | 5.04.00 | Margins : Flow – 15%, Head – 20% | The flow and head of the Gypsum bleed pumps are dependent on the system requirement. We do not recommend provision of any margin on the flow or head of the pumps. Please check your requirement. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 749. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 16 of 51 | 5.04.00 | The pumps shall be designed to meet the stipulations of Clause No.9.00.00 of this Sub-Section. | Please note that in Cl. No. 9.00.00 of this section the the stipulations are specified for vertical pumps but the Gypsum bleed pumps are Horizontal centrifugal type. Please clarify the requirement. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 750. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 16 of 51 | 5.05.00 | An emergency cooling system for automatic spray of quenching water for a sufficient time (minimum 15 min) at the inlet to the absorber, in case the gas temperature exceeds the design temperature due to failure of upstream equipment's shall be provided to protect the FGD and all other sensitive downstream equipment against high flue gas temperatures. | Since Absorber is being provided with alloy steel liner which can withstand temperatures, the requirement of emergency cooling system shall be reviewed. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 751. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 17 of 51 | 5.06.06 | Three stage chevron type Mist Eliminators (ME) made of polysulfone or stainless steel shall be provided at the exit of the absorber. | We recommend polypropylene (PP) made Mist Eliminator elements/lamellas and frames as per manufacturers standard and which are installed at many FGD plants around the world and performing well. Please confrim that M/s NTPC will accept the polypropylene Mist Elimator elemts/lamellas. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 752. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 19 of 51 | 5.06.17 | Nozzle pipes and slurry spray nozzles shall be with bolted flanged connections. | We understand that Nozzle pipes with bolted connections is applicable only if the bidder provides spray banks with carbon steel piping and rubber lining and not for FRP spray header pipes. Please check and confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 753. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 22 of 51 | 6.03.06 | For each bunker facilities shall be provided for unloading the bunker, through feeder, to a truck at ground level, along with all necessary chutes and diversion chutes. | Please furnish the details of truck unloading equipments to be considered by bidder for more clarity. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 754. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 22 of 51 | 6.05.01 | (ii) Flow 110% of limestone requirement of two absorbers at Design point | Please note that as per referred caluse, each wet ball mill has to be sized for 110% of limestone requirement of two absorbers and 2 x 100% wet ball mills to be provided. This is applicable for the plants where there are two units only. Please clarify the quantity of wet ball mills to be considered where no. of units are three (3) and four (4). | Common 2X 100% Wet ball mill for all the units in a plant. |
| 755. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 25 of 51 | 7.04.01 | Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum: | Please note that the solid concentration of gypsump underflow from Primary Hydrocyclone (i.e. inflow to the Vacuum belt filter) will be 50% as per our design standard. Kindly confrim | Noted. |
| 756. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 26 of 51 | 7.04.01 | c. Gypsum Purity 90% (minimum) | It may please be note that since in the tender document Section - VI, Sub section -V, Salient design data & sizing in Note-1 under Cl. No. 6.00.00, the guarantee parameters shall be based on available (reactive) CaCO3 content of 89% and The design of FGD system and auxiliaries reactive CaCO3 content of 79% are specified. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 757. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 26 of 51 | 7.04.03 | Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Employer. | Please note that in the Sub Section - IV, terminal point, under Clause No. 1.10.00 it is specfied that bidder's terminal point is upto outlet of Gypsum Storage silo/shed but in the reference clause it is specified that bidder scope is limited upto inlet of Employers gypsum conveyor. Please calrify the discrepancy. | Refer necessary amendment in this regard. |
| 758. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 29 of 51 | 7.07.09 | The lime storage silo shall be of minimum 24 hr capacity equivalent to the requirements of FGD system of 2X800 MW at Design point and shall be complete with supporting steel structure, platforms, power operated outlet gates, level switches, air relief devices, etc.. | Please note that in the reference clause the lime storage silo storage is specified only for 2x800 MW, whereas various plants are having 3x800 MW, 2x660 MW, 3x660 MW. Hence we understand that bidder to furnish Two (2) Nos 24 Hrs storage capacity lime storage silo common for all the units. Please confirm | Bidder's understanding is correct. |

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| 759. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 29 of 51 | 7.08.02 | The contractor shall provide 2 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours. | Please note that in the technical specification Sub Section - III-A1, Under Cl. No. 6.02.00, only one (1) Number of slurry pump is specified to pump back the slurry from the Auxiliary/ Emergency absorber tank to any of the absorber in maximum time of 8 Hrs. Please clarify the discrepancy and confirm the actual qunaity of slurry pumps to be considered by bidder. | Bidder to refer necessary amendment in this regard. |
| 760. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 29 of 51 | 7.08.04 | The Auxiliary Absorbent tank shall be made of minimum 7 mm thick carbon steel with minimum 4 mm thick rubber lining of best quality bromine butyl rubber..... | We understand that Bidder to furnish the absorber oxidation tank, absorber tower with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 /Alloy 59 or better material, only the Auxiliry absorber tank shall be provided with 4mm thick rubber lining. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 761. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 30 of 51 | 8.03.00 | The slurry concentration in the pump shall not exceed 30% by weight except for Mill circuit slurry pumps for which the slurry concentration in the pump shall not exceed 55% by weight. | Please note that the concentration of mill circuit slurry pumps will vary from supplier to supplier. Hence please confirm that the concentration of Mill circuit slurry pumps will be as per Manufacturer standard. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 762. | SECTION-VI, PART-B | SUB-SECTION-I-M1 | 30 of 51 | 8.09.00 | The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft. | We understand that the slurry pump shaft should be designed to operate at critical speed which is 20% higher than the operating speed. Kindly confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 763. | SECTION-VI, PART-B | SUB-SECTION-I-M3 | 3 of 7 | 7.02.00 | Air Drying (ADP) Plant may be of "Open Through type (Blower reactivated)" OR "Heat of (HOC) Compression type". | As per referred clause, both Blower Reactivated and HOC type ADP are acceptable. But, in Mandatory Spares, only spares for Blower Reactivated type ADP gas been mentioned. Please clarify whether HOC type ADP is acceptable or not. If yes, please funish the mandatory spares list for HOC type ADP. | As specified in referred clause, HOC type ADP is acceptable. Bidder to refer relevant amendment in this regard. |
| 764. | VI A | III | | 1.06.00 | **First fill of Consumable, oil & Lubricants**. All the first fill and one year topping requirement... | Lime stone & Chemicals shall be supplied by NTPC. Pl confirm | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 765. | | III-A5 | | 2.01.01 | Lime stone received thru ..... Crusher house | Truck tippler are not required for self tippling Trucks. Please clarify that sytem should be designed considering Truck Tipplers or system to be designed considering non tippling Trucks | System shall be designed considering all types of trucks including self tippling trucks as specified in the technical specifications. |

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| 766. | | III-A6 | | 1.01.00 | Pretreatment system.....**GGH washing**..... | GGH is not applicable. Please confirm | Bidder's understanding is correct. |
| 767. | VI B | VI | | 3.03.09 | .... GGH ..... | GGH is not applicable. Please confirm | Bidder's understanding is correct. |
| 768. | | | | | MEJA - General Layout Plan Drg No 0360-999-POC-F-001 Rev 6 D0 | Space for FGD is not indicated. Kindly provide the same | Bidder to refer Amended GLP being issued separately. |
| 769. | | | | | | space for FGD is not indicated. Kindly provide for Nabinagar 3 x 660 MW also | Bidder to refer Amended GLP being issued separately. |
| 770. | VI, PART-B | I-M7 | 5 of 32 | B. 1) | The FGD wastewater treatment system shall be designed to treat the FGD waste water of all units of Plant for 24 hours continuous operation per day and seven (7) days per week except during annual cleaning period. | In both clauses, operating hours of waste water treatment plant are not matching. Please clarify the same, 16 hours or 24 hours. | Technical specification requirement is clear. Pretreatment facilities shall be designed to treat the FGD waste water genetrated for all units of Plant in 24 hours & any other waste water as envisaged by Bidder considering 16 hr of operating time. However, Evaporative concentration processes shall be deigned considering 24 hours op- |
| | VI, PART-A | VI | 20 of 24 | xvii) of 4.00 | C). Operating time : 16hr for Pretreatment process, 24hr for Evaporation process | | |

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| | | | | | | | erating time. |
| 771. | VI, PART-B | I-M7 | 6 of 32 | 12) of B | 12) The Contractor shall design the FGD wastewater treatment system to the sludge quantity. The sludge from clarifiers shall be transferred to thickeners and reuse gypsum storage tank. The overflow of thickeners shall be transferred to the FGD wastewater tank/pond, and the thickened sludge shall be transferred to the filter press for sludge dewatering and reuse. | As per clause no. 12) of B, thickener is envisaged to increase sludge consistency before feeding to Filter press. However, in process flow diagram, thickener is not shown. Please clarify the requirement of thickener. | Thickner is envisaged in the scope of the Bidder. Process flow diagram is indicative Contractor to furnish the complete scheme & P&ID during detailed engineering meeting the specification requirements. |
| | PART-E | | | | Process Flow Diagram for FGD Waste water treatment (FGD WWT) for ZLD Drawing no. 0011-109-POM-A-005 Thickener is not shown | | |

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| 772. | VI, PART-B | I-M7 | 11 of 32 | 2) of G. | 2) The Contractor shall design chemical tanks as followings:<br>a) Chemical storage tanks : 15 days<br>b) Chemical dissolving tank : 3 days<br>c) Chemical dosing/injection tank : 24 hours | We have considered that chemical storage tank, chemical dissolving tank and chemical dosing tank shall be located open dyke area. Please confirm. | This shall be decided during detailed engineering as per the proven practice of the contractor. |
| 773. | VI, PART-A | IV | 1 of 3 | 1.08.00 | Terminal point of waste water | In the mentioned tender clause, scope of disposal of sludge/slurry generated from filter press and centrifuge are not specified. We understand that disposal of the same are in client scope. Please confirm our understanding. | Bidder's understanding is in order. |
| 774. | | | | | | As seen from the GLP of various projects the space earmarked for FGD system is less than the requirement. To accommodate FGD system, some facilities/ roads are to be reloated. Please confirm. | Bidder to refer amended GLP. |
| 775. | | | | | | Since space for Lime stone storage/handling system is not marked in any of plot plan attached with tender specifications, we assumed that space shown as future provision for coal stockpile/storage can be utilized for | Bidder to refer amended GLP. |

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| | | | | | | limestone handling/storage system. Please clarify. | |
| 776. | | | | | | Please provide flow diagram of Limestone and Gypsum handling system for each project. | Space available for FGD and associated system is marked in the General Layout Plan drawings attached with the Technical Specifications. Bidder has to propose the layout and Limestone Flow Diagram for LHP & GHP to cater the requirement of FGD plant based on the layout of FGD system and existing facilities. |
| 777. | | | | | | In case of Truck Tippler, we have considered Vibrating feeder of unbalanced motor type below hopper. Please confirm. | Noted. |

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| 778. | Sec-VI, Part-A | III-A5 | 2 of 6 | 2.01.02 | | As the limestone handling system shall be double stream up to limestone grinding building, please clarify whether a set of One Vibrating Grizzly feeder & One Impactor Crusher shall be considered for each incoming conveyor in Crusher House. So that one stream shall be 100% standby. | Noted. |
| 779. | | | | | | Incase lime stone receiving arrangement is through existing Wagon Tippler or Track hopper, please clarify whether existing equipment below Wagon tippler hopper or track hopper are suitable to handle the desired capacity of limestone and the same equipment shall be used as it is, need not to modify. Please clarify. | Confirmed. |
| 780. | | | | | | Please clarify whether sufficient spaces are available for taping/receiving of limestone from the existing system. | Bidder to examine the feasibility. |
| 781. | Sec-VI, Part-A | III-A5 | 2 of 6 | 2.01.00 | | Please refer cl. No. 2.01.00, page 2 of 6 of technical specification, section – VI, Part – A. Please indicate name of the projects where Truck unloading system only to be considered and name of the projects where existing Wagon tippler / | Technical Specifications is clear. Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes. |

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|---|---|---|---|---|---|---|---|
| | | | | | | Track hopper are only to be considered for receiving of limestone. | Road unloading facility shall be provided for all the plants under this package. Wherever feasible, railway unloading shall also be provided using existing Wagon Tippler / Track Hopper as detailed out in the Technical Specifications. |
| 782. | Sec-VI, Part-A | III-A5 | 3 of 6 | 2.01.07 | | As the reclaiming capacity is less, please clarify whether limestone can be reclaimed from crushed limestone storage shed through traveling hopper (shall be provided over reclaime conveyor) with the help of pay loader. | Technical Specifications is clear. Bidder shall comply. |
| 783. | Sec-VI, Part-A | III-A5 | 5 of 6 | 2.01.28 | | We understand weighing bridge is required for Road Truck only. For railway wagons, weighing bridge is already exists. Please clarify. | Confirmed. |
| 784. | | | | | | Please furnish AutoCAD version of GLPs for developing FGD and LHP & GHP system layouts | Only PDF provided. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SL. No | SECTION | SUB SECTION | PAGE NO. | CLAUSE NO. | DESCRIPTION | QUERY | NTPC CLARIFICATIONS |
|---|---|---|---|---|---|---|---|
| 785. | Sec-VI, Part-B | IV-D | 11 of 69 | 3.14.01 | The expansion joint in the flue liner shall ..... A temperature of 300$^0$C, shall be ..... | Please note that wet chimney is installed on downstream of absorber and will be operational while FGD is in service only and temperatures would be around 60-80$^0$C only. Hence please review the temperature requirement for expansion joint. | Specification requirement is clear under the referred cl.no. 3.14.01 . Bidder to comply with the specification requirements. |

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| 786. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 5.06.06 | 18 of 51 | The mist eliminator wash piping shall be constructed of rubber lined carbon steel or glass fiber reinforced plastics. | Carbon steel pipe shall be selected for outside pipe up to the nozzles at Mist Eliminator casing. Inside the mist eliminator casing piping header shall be of FRP/CSRL as per tender specification. | Specification requirement is clear under the referred cl.no. 5.06.06 . Bidder shall comply with the specification requirements. |
| 787. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 8.04.00 | 30 of 51 | The flushing water for the pumps shall be taken form the process water supply | Bidder envisages to use reclaim water for the flushing of slurry pumps (3-5% slurry concentration) according to our collaborator proven practice. | Specification requirement is clear under the referred cl.no. 8.04.00 . Bidder shall comply with the specification requirements. |
| 788. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 7.04.04 | 26 of 51 | In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. | The size of Vacuum belt filter will decide the extent of modularization and hence the final assembly requirement at site. This will in turn govern the requirement of site joint (vulcanized) for rubber belts. | Specification requirement is clear under the referred cl.no. 7.04.04. Bidder shall comply with the specification requirements. |

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| 789. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 6.02.02 | 21 of 51 | The top of the unloading hopper shall be equipped with a grate to protect the downstream equipment from gravel lumps or tramp waste. | There is no unloading hopper in the lime storage silo, material is discharged to silos through the fixed tripper / plough provided above the silos. The line mentioned " The top of unloading hopper ..... tramp waste" is not applicable for storage silos. Kindly confirm. | The referred cl.no. 6.02.02 is for the Limestone storage silo. The specified requirements shall be complied i.e. "The top of the Limestone storage silo shall be equipped with a grate to protect the downstream equipment from gravel lumps or tramp waste." |
| 790. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 5.06.10 | 19 of 51 | The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as well as intermittently. | Bidder understands the gas cooling mechanism which is continueously operated and is provided in the raw gas inlet duct of absorber meets the requirement. Kindly confirm. | Specification requirement is clear under the referred cl.no. 5.06.10 . Bidder shall comply with the specification requirements. |
| 791. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 7.07.06 | 28 of 51 | .....pumping the waste water from waste water tank at required pressure to waste water terminal point..... | Kindly provide us the head required at waste water terminal point. | Bidder to decide the same based on the proposed and approved Layout during the detail engg.. |

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| 792. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 5.06.11 | 19 of 51 | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br>The absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining I cladding I wall paper of Alloy C276 I Alloy 59 or better material. | Bidder proposes absorber vessel material as CS + FIRP (flake glass) Lining –3 mm Thick as per collaborator experience. Please confirm. | Specification requirement is clear under the referred cl.no. 5.06.11 . Bidder shall comply with the specification requirements. |
| 793. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 6.02.06 | 21 of 51 | For each silo facilities shall be provided for unloading the bunker, through feeder, to a truck at ground level, along with all necessary chutes and diversion chutes. | Kindly let us know the purpose of limestone unloading into a truck at the ground level. Also furnish the type of feeder to be considered, in case above is required.<br>In general, Rotary air lock valve with the telescopic chute is required to load material on to trucks. Please clarify the requirement. | Specification requirement is clear under the referred cl.no. 6.02.06. Bidder shall comply with the specification requirements. |

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| 794. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 7.08.01 | 29 of 51 | The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with<br>all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump. | The two clauses are contradictory. Bidder understands that only one common auxillary absorbant tank is required. Kindly clarify. | Bidder's understanding is correct. |
| 795. | SECTION- VI, PART-A/ SUB SECTION-111-A1FGD | 6.01.00 | 5 of 9 | The employer shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. | | |

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|---|---|---|---|---|---|---|
| 796. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 7.08.01 | 29 of 51 | The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with<br>all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump It should be possible to discharge the each absorber into the emergency drain tank within 2 hours. | Draining of absorber using a pumping system is possible between normal slurry level and minimum slurry level.<br>The balance slurry will be drained to the drain sump by gravity. Kindly confirm. | Noted. |
| 797. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 12.02.00 | 33 of 51 | All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes of size lower than 3" made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. | Bidder proposes FRP as alternative material for all sizes of slurry pipes, please confirm. | Specification requirement is clear under the referred cl.no. 12.00.00. Bidder shall comply with the specification requirements. |
| 798. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 1.09.00 | 4 of 51 | Noise level | Bidder understand that for ball mill noise level limit shall be<90 dB(A). Please confirm. | Bidder to refer necessary amendment in this regard. |

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| 799. | SECTION – VI, PART-C / General technical requirements | 30.00.00 | 42 of 83 | Noise level <90 dB(A) | | Bidder to refer necessary amendment in this regard. |
| 800. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 3.01.00 | 5 of 51 | Recirculation Slurry pH Not less than 5.5 under all operating conditions | This clause is not applicable to Jet Bubbling technology offered by the bidder. Please confirm. | Specification requirement is clear under the referred cl.no. 3.01.00 . Bidder shall comply with the specification requirements. |
| 801. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 6.05.01 | 23 of 51 | Limestone bond index(kWh/sh. T) 13 (min) | Bidder considers Limestone bond index as 13 kWh/metric ton. Please confirm. | Limestone Bond Index : 13 kWh/Sh.T (Min.) should be followed. |
| 802. | SECTION-VI, PART·A/SUB·SECTION·V SALAIENT DESIGN DATA & SIZING | 6.00.00 | 10 of 26 | Bond Index 13 kWh/t | | |
| 803. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 15.01.00 | 36 of 51 | One (1) no. Passenger cum goods elevator per Absorber & for Mill Building | Bidder understands that passenger cum goods elevator of minimum capacity of 1000 kgs for each absorber shall be required only if height of absorber is higher | Bidder to refer necessary amendment in this regard. |

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| 804. | SECTION – VI, PART-A / SUB-SECTION-III-A1 (FGD) | 9.01.00 | 7 of 9 | One (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for each Absorber (to be provided in case height of absorber is higher than 20m) .... | than 20M. | |
| 805. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 5.01.00 (iv) | 14 of 51 | The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side. | Slurry recirculation pumps are not applicable to our offered system. The Gas Cooling pumps provided in our system shall have motor driven/pneumatic butterfly/knife gate valve. | Specification requirement is clear under the referred cl.no. 5.01.00 (iv). Bidder shall comply with the specification requirements. |
| 806. | SECTION-VI, PART·A/ SUB·SECTION·V SALAIENT DESIGN DATA & SIZING | 6.00.00 | 10 of 26 | Limestone characterstics CaO 47-51 | Bidder will consider CaO of 51 % not only for guarrantee parameters but also for our complete FGD system design. Please confirm. | Bidder's understanding is not correct. Bidder shall comply with the specification requirements at referred cl.no. 6.00.00 and relevant clauses of sizing & design in the tender specifications . |
| 807. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 1.03.02 | 2 of 51 | Motorized Guillotine type gates has be provided at.....(iii) in the bypass duct(common Flue Gas Duct going towards the existing Chimney). | Already a Bi-plane motorized/pneumatic is asked in the bypass duct in 3.03.01. Purpose of this Motorized Guillotine type gates damper to be clarified. | Specification requirement is clear under the referred cl.no. 1.03.02 . Bidder shall comply with the specification requirements. |

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| 808. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 5.01.00 B | 14 of 51 | .....However, 2x100% Cooling Pumps Instead of Slurry Recirculation shall be provided. The spray headers & piping for cooling pump discharge shall be made of Alloy 59 or C276 and nozzles shall be made of Silicon Carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs | The slurry spray headers within the gas cooler shall be made of Alloy 59 or C276. The piping outside the gas cooler, which is not in contact with hot flue gas & slurry spray shall be CS with rubber lining. Kindly confirm | Specification requirement is clear under the referred cl.no. 5.01.00 . Bidder shall comply with the specification requirements. |
| 809. | SECTION – VI, PART-A / SUB-SECTION-VI (FUNCTIONAL GUARANTEES) | | | Functional Guarantees & Liquidated Damages | General Comments:<br>Detailed performance guarantee test requirements such as test duration, flue gas/limestone consumption measuring method, liquid/solid analytical method, evaluation method of collecting data are not mentioned in the tender document. Our understanding that bidder can propose performance guarantee test procedure during detail engineering stage in line with collaborator standard practice. Please confirm. | Specification requirement is clear under the referred SECTION – VI, PART-A / SUB-SECTION-VI (FUNCTIONAL GUARANTEES). Bidder shall comply with the specification requirements. |

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| 810. | SECTION- VI, PART-A/SUB SECTION-III-A1 FGD | 6.02.00 | 5 of 9 | The contractor shall provide 1 x100% slurry pumps... | The two clauses are contradictory. Kindly clarify. | Bidder shall provide 1x100% slurry pumps.<br><br>Bidder to refer necessary amendment in this regard. |
| 811. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 7.08.02 | 29 of 51 | The contractor shall provide 2 x100% pump | | |
| 812. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 3.01.00 | 5 of 51 | Inlet Dust Burden in Gas (mg/Nm3) 200 | ESP is designed for outlet dust burden of less than 50 mg/Nm3 as per statutory requirements. Hence, inlet dust burden of 200 mg/Nm3 is rather high. Bidder requests to kindly review the same. | Specification requirement is clear under the referred cl.no. 3.01.00. Bidder shall comply with the specification requirements. |
| 813. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 4.03.00 | 10 of 51 | Fan component shall also be designed to withstand the excursions in flue gas temperature up to 300 degree Celsius, which may persist for about 30 minute duration..... | Bidder request NTPC to review this clause for fans as most of the suppliers are unable to meet the requirement. | Specification requirement is clear under the referred cl.no. 4.03.00. Bidder shall comply with the specification requirements. |

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| 814. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 13.03.07 | 34 of 51 | All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell thickness. | The two clauses are contradictory. Bidder shall consider 1.5mm corrosion allowance. Please confirm. | Bidder to refer necessary amendment in this regard. |
| 815. | SECTION – VI, PART-B SUB·SECTION·I·M 1 | 13.01.00 | 33 of 51 | Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the bidder. | | |
| 816. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 3.01.00 (3) | 5 of 51 | The entire flue gas system, flue gas ducts, absorber etc. shall be designed to meet the following conditions:Short temp excursion temperature of inlet gas (for approx. fifteen (15) minutes at a time) (deg. C) 300 | In case of offered technology, since the absorber is preceeded by the gas cooling system (including emergency cooling water system), we don't envisage 300 Deg c excursion temperature at absorber. Hence this clause is not applicable for offered absorber. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 817. | SECTION-VI, PART-A/ SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS | 1.06.00 | 2 of 3 | For Gypsum washing, Contractor shall take a tap off suitably from the existing HVAC header (HVAC make up pump discharge) available along C-row at CD bay rack for meeting the water requirement of Gypsum washing. | Bidder requests NTPC to provide water analysis for gypsum washing requirement. | Bidder to refer Project information chapter for project specific details. |
| 818. | SECTION – VI, PART-A / SUB-SECTION-II-A10 Project Information BARH STPP STAGE-I (3X660 MW) | | 28 of 30 | Table-4 | Bidder understands that table 4 is clarified water analysis. Please confirm. Bidder understands that COC of 5 shall be considered for arriving at CW blow down analysis for the design/guarantee of FGD. | Bidder's understanding is in order. |

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| 819. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 1.03.06 | 3 of 51 | The FGD and the ancillary facilities shall be suitable for unlimited operation with all transients and at any load point between the minimum and maximum load point of the Steam Generator. Further, the FGD plant shall be suitable for an unlimited operation at any pollutant concentrations between minimum and maximum without exceeding the emission values of S02 emission of less than 100 mg/Nm3 (6% 02 dry). | Bidder shall design considering Guarrantee point is 100% TMCR & worst coal and corresponding SO2 removal efficiency is 96.55% and design point is VWO & worst coal and corresponding SO2 removal efficiency is 96.55%. In view of non availability of data between minimum and maximum load point of steam generator, bidder shall design FGD system and ancilliaries and commit SO2 emissions less than 100 mg/Nm3 with 6% O2 dry for the two points given above. Please confirm. | Specification requirement is clear under the referred cl.no. 1.03.06 . Bidder shall comply with the specification requirements. |
| 820. | SECTION-VI, PART·A/ SUB·SECTION·V SALAIENT DESIGN DATA & SIZING | 1.00.00 | 1 of 26 | Guarrantee point is 100% TMCR & worst coal and corresponding SO2 removal efficiency is 96.55% and design point is VWO & worst coal and corresponding SO2 removal efficiency is 96.55% | | Specification requirement is clear under the referred cl.no. 1.03.06 . Bidder shall comply with the specification requirements. |

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| 821. | SECTION-VI, PART-A/ SUB-SECTION-V SALAIENT DESIGN DATA & SIZING | 2.00.00 | 3 of 26 | The Flue Gas Desulphurisation (FGD) System FOR MOUDA-11 2X660 MW, TANDA-11 2X660 MW, NABINAGAR-1 3X660 MW, MEJA-1 2X660 MW & BARH-1 3X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below: | Please confirm for FGD system design which table shall be applicable for MEJA-1 2X660 MW. | Bidder to refer necessary amendment in this regard. |
| 822. | SECTION-VI, PART-A/ SUB-SECTION-V SALAIENT DESIGN DATA & SIZING | 3.00.00 | 5 of 26 | The Flue Gas Desulphurisation (FGD) System for SOLAPUR-11 2X660 MW & MEJA-1 2X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below: | | Bidder to refer necessary amendment in this regard. |

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| 823. | Section- IV, Sub section-II-E12 | 1.01.00 | | Outdoor transformers | Except control and lighting transform-er(dry types) all other transformers irre-spective of its rating shall be oil filled outdoor types. Employer to confirm that the understanding is correct. | Please refer amendment to Technical Specification (Sec-tion VI).<br><br>Bidders understanding is correct.<br>Bidder's understanding is correct.<br>The Specification for Dry type Transformer is men-tioned in Amendment of Technical Specification Sec-tion VI Part-B Sub section-II-E12<br>outdoor Transformers Clause 7.00.00. |
| 824. | Section- IV, Sub section-II-E11 | 6.02.00 | | Battery- The minimum voltage at the end of load cycle shall not be less than 1.75 volts per cell. | Bidder understands that battery for DG set shall be Lead acid plante type. Please confirm. | Confirmed |
| 825. | Section- IV, Sub section-II-E11 | | | | We presume that DG shall also be solidly earthed, Since 415V AC system is solidly earthed. | DG system shall be kept un-earthed. |

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| 826. | SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT | 1.10.00 | | EARTHING AND LIGHTNING PROTECTION<br>Complete below ground earth mat and above ground equipment earthing system and lightning protection for the plant and equipment under contractors scope along with its interconnection to the nearest employers earth grid at two points. | 1) We understand that for FGD area separate step & touch potential calculation is not required. Calculation shall be to check ground resistance within limits.<br>2) Employers to specify the ground resistance limits.(1 ohms or 5 ohms) | 1. Bidder shall comply with requirement of technical specifications clause no:- 5.01.00 |
| 827. | SUB SECTION-II - E6<br>CABLING, EARTHING &<br>LIGHTNING PROTECTION | 6.00.00 | | LIGHTNING PROTECTION SYSTEM<br>Lightning protection system shall be in strict accordance with IEC : 62305 and latest IS standards. | Lighting protection calculation shall be as per IEC 62305. Accordingly, FGD system if found protected by near by stack or any other higher structures, air terminations and lightning conductors shall not be provided. Please confirm. | The shall be decided during detailed engg. |

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| 828. | SUB-SECTION-II-E15 | 6.00.00 (h) | | Street lighting primary roads secondary roads | Bidder envisages to provide lighting for auxilliary roads within battery limit of FGD area and shall not provide street lighting of main roads in our scope of work. Kindly confirm | Bidder to provide lighting for roads under his scope |
| 829. | SECTION-VI, PART-B, SUB-SECTION 11-E-16 | 1.00.00 | | BATTERY AND DC HEALTH MONI-TORING SYSTEM:- Note: DC health monitoring system shall be offered integral with each battery set for Main Plant & Switchyard batteries. | We understand that health monitoring sytem shall not be applicable to FGD sys-tem battery. Please confirm | Bidder's understanding is correct. |

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| 830. | SECTION- VI, PART-B, SUB SECTION-II-E6CABLING, EARTHING &LIGHTNING PROTECTION | 4.04.13 | | SeparationAt least 300mm clearance shall be provided between:- HT power & LT power cables,- LT power & LT control/instrumentation cables, | We understand that this clause is applicable for hortizonal configuration of cable trays only. Bidder proposes to provide spacing of 100 mm between different tiers of trays for vertical configuration. Please confirm. | When vertical trays are arranged one above the other, 100 mm spacing shall be maintained between bottom of top and top of bottom tray. However 300 mm spacing shall be maintained when vertical trays are arranged side by side |
| 831. | SECTION - VI, PART-B SUB SECTION-11 - E6 CABLING, EARTHING & LIGHTNING PROTECTION | 2.01 .08 | | For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be followed. | Bidder understands the purchaser's cable trestle structure between Power House & FGD Area has space and load capability for fixing the bidder's cable tray (if required) for bidder's supplied cables. Bidder will not consider separate cable trestle structure between Power House & FGD Area. Please confirm. | bidder's understanding is NOT correct. Bidder to provide cable tray and its supports for his scope of cable on employer trestle. In case of non availability of space in employers trestle, bidder to make necessary arrangements for cable tray erection and laying. refer clause no:- 1.08.00.2. However bidder may visit the project in order o get itself acquainted with existing electrical of plant |

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| 832. | SECTION - VI, PART-B SUB SECTION-11 - E6 CABLING, EARTHING & LIGHTNING PROTECTION | 2.01.07 | | Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries. | Bidder understands that referred clause (i.e. separate route) is applicable for Main incoming cable from Power House Building to FGD area. Within FGD internal area, separate route may not be feasible for redundant equipments. | Bidder shall comply with technical specification requirements. |
| 833. | | | | Tender SLD | Bidder requests employers to furnish co-ordinates/location of 11kV switchgears (customer switchgear) and 3.3kV AHP/CHP swgr inorder to enable us to calculate the cable route length. | Refer amended Tender SLD& project GLP. |
| 834. | SECTION- VI, PART-B, SUB SECTION-11-E9 HT SWITCHGEAR | 1.00.00 | | Spare capacity and Future Requirements<br>all MV Switchboards is provided with one spare motor feeder and one transformer feeder on each section for future requirements. | Please note that motor spare feeders may not be appicalbe in 11kV FGD switchgear, in case there is no motor feeder envisaged to be supplied from this board. | This clause is DELETED.<br><br>Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI)<br>This clause is deleted. Please refer Amendment to Technical Specification (Section |

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| | | | | | | VI) |
| 835. | | Note. 7 | | Bidder shall provide DC system of adequate capacity for meeting DC loads in FGD area | Bidder proposes to consider 1 set of Battery with charger system for all DC loads requirement for entire FGD area. Please confirm. | Requirement of Technical Specification is clear. Bidder shall provide DC system as shown in Tender SLD with 2 sets of Battery and Battery Chargers. |
| 836. | SECTION-VI, PART-A, SUB-SECTION-IV, TERMINAL POINTS & EXCLUSIONS | 1.14.00 c) & d) | | c) One (1) no. 240V, single phase, 50 Hz feeder per unit for meeting the unregulated AC power supply requirement for illumination, heating,ventilation, and utility outlets, etc. at bidder's Power supply distribution panel.<br>d) Two (2) 415 V, 3- phase 3 wire, 50 Hz feeder for each set of the bidder's 24 V DC system. | Please provide the coordinates/ location of the board from which One (1) no. 240V supply and Two (2) 415 V supply shall be provided. | Bidder to refer necessary amendment in this regard. |

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| 837. | SECTION- VI, PART-B, SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION | 9.00.00 b) | | Separate Switchgear Rooms shall be provided for each unit. For TG building, all HT boards shall be provided in HT switchgear room at only one floor and all L T boards shall be provided in L T switchgear room at only one floor | Bidder understands that this clause is not applicable for FGD Package. Please confirm. | Bidder understanding is clear. |
| 838. | General | - | - | - | Bidder requests owner to provide soil resisitivity report for FGD area for Barh-I, Nabinagar, Darlipalli-I, Gadarwara-I, Lara-I, Kudgi-I, Meja-I, Mouda-II, Solapur-II, Nabinagar-I & Tanda-II projects. | Bidder to refer necessary amendment in this regard. |
| 839. | VI / A / IIIB | 1.12.00 | 4 of 6 | To meet the construction power requirement of the FGD and associated systems,the Employer shall provide Two Number 415V feeders in LT switchgears. | Bidder requests owner to mark the exact coordinates for Construction power supply in GLP of respective projects. | This shall be intimated to Bidder during detailed Engineering. |

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| 840. | VI / A / IV | 2.00.00 | 3 of 3 | **EXCLUSIONS** | Bidder requests owner to specify exclusions (if any). | Bidder shall comply with Technical Specification requirement. |
| 841. | VI / A / II E-1 | 2.08.00 | 5 of 7 | An ageing factor of 1.25 shall be considered. | Bidder would like to clarify that for Plante batteries the applicable ageing factor shall be 1.0 as per IEEE 485. Owner may please confirm. | Bidder shall comply with Technical Specification requirement. |

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| 842. | VI / A / II E-2 | 3.01.00 (b)<br><br>8.00.00 | 2 of 9<br><br>5 of 9 | Continuous duty LT motors up to 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30.<br><br>The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.<br>(a) Below 110KW : 11.0<br>(b) From 110 KW & up to 200 KW : 9.0<br>(c) Above 200 KW & up to 1000KW : 10.0<br>(d) From 1001KW & up to 4000KW : 9.0<br>(e) Above 4000KW : 6 to 6.5 | Bidder would like to clarify that the starting current for IE3 motors shall be followed as per IS 12615 only. Owner may please confirm. | Bidder shall comply with Technical Specification requirement. |

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| 843. | VI / A / II E-4 | 3.01.00 (b) | 4 of 6 | 1.1KV grade PVC power cables shall have aluminium conductor(compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I). | Bidder proposes Copper conductor for 2.5 & 4 sq.mm cable sizes. Aluminium conductor shall be used for 6 sq.mm & higher sizes. Owner may please accept bidder's consideration. | Bidder shall comply with technical specification requirements |
| 844. | VI / A / II E-6 | 2.01.04 | 2 of 69 | No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant. | Bidder understands that cable trenches can be considered in Gypsum / Limestone Handling System MCC Room/ FGD switchgear room / Control Room. Owner may please confirm. | Bidder understanding is correct. |
| 845. | VI / A / II E-10 | 4.22.00 | 12 of 58 | Employer reserves the right to alter the cable entries, if required during detailed engineering, without any additional commercial implication. | Bidder understands that LV switchgear can have top or bottom cable entry. Owner may please confirm. | Confirmed. Please refer clause no. 6.08.00 for clarity. |

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| 846. | VI / EELECTRICAL SINGLE LINE DIA-GRAM FOR FGD PACKAGE(Drg no. 0011-109-POE-J-001/A-E rev A) | - | - | - | Bidder requests owner to specify MVA rating for 11/3.45kV EXISTING CHP/AHP Transformers fed from 11kV FGD switch-gear. | Please refer AMENDMENT TO TECHNICAL SPECIFICA-TION (SECTION VI). |
| 847. | VI / E ELECTRICAL SIN-GLE LINE DIA-GRAM FOR FGD PACKAGE (Drg no. 0011-109-POE-J-001/A-E rev A) | - | - | Note<br>3 - Standard LT Transformers rat-ings are as follows:<br>2500/2000/1600/1000/630 kVA | Bidder requests owner to accept LT transformers of rating 1250kVA & 750 kVA in addition to the range mentioned in the referred clause. | Bidder shall comply to Technical Specification. |
| 848. | Section-VI PART-A, Sub-Section-III-C (C&I) | 2.01.00 | 2 of 8 | Primary instruments like... **vibra-tion transmitter**.. | Bidder understands that as specified in Section-VIA Sub-Section-IIIC (C&I), Vibra-tion transmitters shall be considered for vibration monitoring of all critical HT drives in Bidder's scope & same shall be hardwired to FGD PLC system. Accordingly no dedicated Vibration Monitoring Sys-tem is envisaged for the same. | Bidder's understanding is correct. However, vibration measurement is envisaged for each vibration measure-ment point as indicated in a)Tender drawing "0011-109-POM-A-001"<br>b) PART A, Clause 23.01.00 |
| 849. | Section-VI PART-A, Sub-Section-III-A5, Limestone & Gypsum Handling Plants | 2.01.06 | 3 of 6 | Suitable numbers of hammer crusher complete with drives,...., **vibration monitoring system** etc. | | |

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| 850. | Section-VI PART-B, Sub-Section-I-M6, Limestone Handling Plant (LHP) | 4.9.3 (vii) | 12 of 73 | Crusher shall be provided with **vibration monitoring (VMS) system**. Specification of VMS shall be as specified elsewhere. | Kindly confirm. | of sub section III-A1<br>c) PART-A, Clause 2.01.06 of sub section III-A5.<br>It is further clarified that as per clause 1.07.00 of sub section III-C2 PART B of technical specification, vibration measuring instrumentation shall be as per the standard and proven practice of the bidder. Vibration measuring instrumentation output (4-20mA) shall be connected to FGD control system instead of vibration monitoring system. |
| 851. | Section-VI PART-A, Sub-Section-III-C (C&I) | 9.01.00 | 8 of 8 | Hardwired Signal exchange:... Contractor shall provide Remote Input Output (RIO) for PLC per unit, placed in Central Equipment Room (CER) for the same. | Since common PLC system is considered for FGD of all Units & its associated systems, Bidder understands that PLC RIO panel **common for all Units**, shall be considered at CER.<br>Kindly confirm. | Bidder's understanding is not correct.<br>Remote Input Output (RIO) panel, located in respective unit (s) CER, for hardwired signal exchange between FGD PLC and BOP DDCMIS of respective unit (s) shall be |

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| | | | | | | provided on per unit basis. |
| 852. | Section-VI PART-A, Sub-Section-III-C (C&I) | 9.02.00 (2) | 8 of 8 | Contractor shall provide neces-sary hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for transfer of signals... | Bidder understands that only supervisory monitoring of FGD system is envisaged through Station LAN connectivity, and type of connectivity/no. of signals to be transferred, shall be considered accord-ingly.<br>Owner to kindly confirm. | Bidder's understanding is correct that supervisory monitoring of FGD system is envisaged through Station LAN connectivity. However, bidder to further refer clause 9.02.00, PART-A Sub Section-IIIC, wherein it is mentioned that it is also envisaged to control, operate and monitor FGD and associated system remotely from main plant Central Control Room (CCR). Bidder shall comply with the specification requirement. |

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| 853. | Section-VI PART-B, Sub-Section-III-C4, Instrumentation Cables | 8.05.00 | 10 of 13 | The cables emanating from redundant equipment/devices shall be routed through different paths. | Considering the space constraint for FGD system, different path for cables from redundant equipments is not feasible. Owner to kindly consider. | Specification requirements are clear. Bidder shall comply with the specification requirement. |
| 854. | Section-VI PART-B, Sub-Section-III-C5, PLC Based Control System | 3.01.01 | 8 of 27 | Input used for interlock/protection shall be dual redundant. | Bidder understands that indicated redundancy refers to redundancy of field instruments, and not the signal (input channel) redundancy.<br>Kindly confirm. | Bidder's understanding is not correct.<br>Bidder to refer clause 3.01.01, PART-B Sub Section-IIIC-5, wherein it is mentioned that each of the redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement scheme of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these |

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| | | | | | | modules can be used by other inputs of the same functional group. |
| 855. | Section-VI PART-B, Sub-Section-III-C5, PLC Based Control System | 3.01.04 | 8 of 27 | The on-off status of HT drives etc, however, be wired to two input modules in parallel. | Bidder understands that as per referred clause 'on' status of HT drives shall be wired in input module parallel with its 'off' status.<br>Kindly confirm / clarify. | Bidder's understanding is not correct. It is clarified that ON status of HT drive shall be wired to two input modules in parallel. Similarly OFF status of HT drive shall be wired to two input modules in parallel. |
| 856. | Section-VI PART-B, Sub-Section-III-C5, PLC Based Control System | 5.03.07 | 13 of 27 | For the drives, the command shall be provided through redundant O/P module to MCC/SWGR/Actuator **as applicable**... | Output signal redundancy is not specified in the Tender, hence Bidder understands that the same is not applicable.<br>Kindly confirm / clarify. | Bidder's understanding is not correct.<br>It is clarified that output redundancy is applicable for 10% of drives distributed in various functional groups (Exact application shall be finalized during detailed engg.) Please refer amendment in this regard. |

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| 857. | Section VI / Part A / Sub Section III A1 | 25.00.05 | 9 of 9 | A common nickel based alloy material storage/neutralization tank for both the units of storage capacity of 12 hrs of stack condensate of both the stack shall be provided. | Please confirm the following:1) In case of single flue chimneys, bidder would like to consider separate tanks for each unit, with storage capacity of 6 hrs. of stack condensate for one unit.2) Bidder would also like to explore the option of providing the tank directly below the stack liners on the grade slab.3) Bidder would like to consider CS+2mm wallpaper made of nickel based alloy. | Bidder to refer necessary amendment in this regard. |
| 858. | Section VI / Part A / Sub Section III A1 | 25.00.05 | 9 of 9 | Alternatively bidder may propose his proven system for the disposal of condensate... | Bidder would like to propose the use of condensate collected from the stack into the water system of the FGD absorber. Kindly confirm. | Bidder shall comply with the specification requirements. |
| 859. | Section VI / Part A / Sub Section III A1 | 2.06.00 | 2 of 9 | Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor (in Employers scope). The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor being provided by the Employer. | Bidder understands that gypsum handling system is in bidder's scope. Please confirm. | Bidder's understanding is correct.<br>Bidder to refer necessary amendment in this regard. |

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| 860. | Section VI / Part A / Subsection III A5 | 3.01 .00 | 6 of 6 | Gypsum shall be conveyed from the vacuum belt filter to the storage shed through a series of double stream conveyors and transfer points/junction towers. | | |
| 861. | Section VI / Part A / Sub Section III A1 | 3.00.00 | 2 of 9 | The contractors scope shall include a common limestone grinding system for all the units and shall comprise of…….. | Bidder understands that limestone handling system is in Bidder's scope. Kindly confirm. | Bidder's understanding is correct.<br>Bidder to refer necessary amendment in this regard. |
| 862. | Section VI / Part A / Subsection III A5 | 2.01.00 | 2 of 6 | Limestone Handling Plant (LHP) | | |
| 863. | Section VI / Part A / Sub Section III D CIVIL WORKS | 1.06.00 | 2 of 4 | Uniform Finished Ground Level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing. | Bidder understands that filling / cutting of earth is in his scope in areas other than the main absorber. Kindly confirm. | Refer amendment issued separately. |
| 864. | Section VI / Part A / Sub Section IV Terminal points and Exclusions | 1.10.00 | 2 of 3 | Outlet of gypsum storage silo/ shed | As per section VI, Part-A, Sub Section III - A5, Page 2 of 6, "Gypsum to be conveyed to gypsum storage Shed".<br>Bidder shall consider only a storage shed for gypsum. Kindly confirm. | Confirmed. |

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| 865. | Section VI / Part B / Sub Section IV-D Civil Works | 3.07.00 | 8 of 69 | Gypsum storage shed<br>The gypsum storage shed shall be RCC framed structure with structural steel work shed with permanent colour coated profile steel sheet roof and side cladding... | Bidder requests for an option for the gypsum storage shed to be made of structural steel superstructure with Structural columns and sheeting. Kindly confirm. | Bidder shall follow technical specifications in this regard. Bidder shall also refer s.no.1 of amendment no 1 in this regard. |
| 866. | Project information | | | Wind and seismic codes | Kindly confirm the following:<br>1) Bidder would like to consider IS 875 (Part-3):2015 for wind loading<br>2) Bidder would like to consider IS 1893 (Part 2):2016, "General provisions and buildings" for buildings and IS 1893 (Part-4) : 2015 "Industrial structures including stack - like structures" for stacks along with site specific spectra provided. | Bidder shall comply to site specific "criteria for wind and earthquake resistant design of structures" specified in "Project information" section of technical specification. |
| 867. | Section VI / Part A / Sub Section II-A6 Project information, Solapur (2X660MW) | 7.08.00 | 19 of 31 | Employer has carried out geotechnical investigation in vicinity to the proposed area. Logs of representative boreholes for bidder's information in the vicinity of proposed area are enclosed with | Kindly furnish the annexure mentioned in the clause referred in the specification. | Bidder to refer amendment |

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| | | | | this annexure. | | |
| 868. | Section VI / Part A / Sub Section II-A10 Project information, BARH STPP STAGE-1 (3X660MW) | 2.00.00 | 30 of 30 | List of drawings placed below in this subsection... | The topographical survey drawing no: 9562-999-POC-F-002 is unavailable. Kindly provide the same. | Refer amendment issued Separately. |
| 869. | Section VI / Part A / Sub Section II-A4 Project information, Darlipalli (2X660MW) | 7.00.00 | 10 of 30 | Geotechnical data and foundation system for the respective project are enclosed at annexure III. The corresponding borelogs are enclosed at annexure IV. | Kindly furnish the annexure IV mentioned in the clause referred in the specification. | Bidder to refer amendment |

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| 870. | TANDA-II-A7-2 Annexure-IV tanda-II | | | Bore log data | The co-ordinates of Bore-log provided in the bore logs do not go in conjunction with coordinates in the provided plot plan.<br>Kindly furnish the revised bore-log coordinates<br>in-line with provided plot plan and topo survey. | Bidder may refer Clause No.7.00.02, as mentioned in Clause No. 7.00.02, the available borelog data is of vicinity to proposed structure and the same has already been furnished in the tender document. Detailed Geotechnical Investigation shall be carried out by contractor. |
| 871. | Section VI / Part A / Sub Section II A2 | 5.00.00 | 4 of 48 | Damping in Structures (c) Reinforced Concerete Stacks : 3% | Bidder requests for horizontal seismic acceleration spectral coefficients for damping factor equals to 3% (as a percentage of critical damping). | The same is provided at "criteria for earthquake resistant design of structures" specified in "Project information" section of technical specification except for Lara Project.<br>It will be furnished in the amendment to technical specification for Lara Project. |

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| 872. | Section VI, Part B,Subsection IV-D - Civil works | 39.03.00 | 66 of 69 | Fly ash based Portland pozzolona cement conforming to IS:1489, Part I shall preferably be used. | a) OPC cement mixed with fly ash can also be used for FGD structures except for Chimney. Owner to please confirm.<br><br>b)Clause 39.03.00 is not applicable for Chimney shell. For Chimney shell, bidder have to use OPC cement only. Please confirm bidder's understanding. | a. Bidder shall comply with Technical specification requirement.<br><br>b. For chimney shell, only OPC cement shall be used. |
| 873. | General | | | | Only two borelogs are furnished in the tender document for Barh project. Bidder request Owner to furnish additional bore holes as the FGD structures are located in a scattered manner within the existing units. | Bidder may refer Clause No.7.00.02, as mentioned in Clause No. 7.00.02, the available borelog data is of vicinity to proposed structure and the same has already been furnished in the tender document. Detailed Geotechnical Investigation shall be carried out by contractor. |

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| 874. | Section VI, Part A, Subsection IIID, Page 1 of 4 | 1.04.00 | 1 of 4 | If at any stage of work, any dismantling or modification or relocation of any existing facility is required to be done to complete the work in bidder's scope.....the same shall be done by bidder with no extra cost or time implication to the Employer | Dismantling, rerouting & restoration of existing structures which may foul with proposed FGD facilities need to be identified by Owner before hand. Hence Owner is requested to furnish the below mentioned details which are of utmost importance:a)Project wise list of existing structures/ facilities which can be rerouted to accommodate proposed FGD facilities.b) Facility wise schedule of shutdown window which will be available to FGD EPC contractor for interface activities as well as dismantling and rerouting.c)Owner shall be responsible for taking timely Shutdown of existing operational facilities, if required, in order to facilitate FGD construction work. Please confirm. | Relocation of existing facilities will however depend on the bidder's proposal.<br>Any hindrance and evident underground facilities shall be suitably relocated by the bidder.<br>If during the execution of the works it is found that the facilities in the Contractor's scope are fouling with any existing abandoned foundations and underground trenches including pipe and cable trenches for which the contractor is not provided any drawings by NTPC neither the Contractor was appraised beforehand, the |

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| | | | | | | same shall be dismantled & relocated by station. However, Bidder shall note that any re-routing and modification work that will be suggested by the Bidder in such an eventuality shall be subject to the Employer's approval and, if required, Bidder shall modify his design to suite the actual site conditions. |

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| 875. | Section VI, Part A, Subsection IIID, Page 1 of 4<br><br>Section VI, Part B, SubSection IV-D | 2.00.00<br><br>12.00.00 | 2 of 4<br><br>30 of 69 | Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete (M 35) as per IRC....Width of all such roads shall be 7.5 M concrete pavement.<br><br>The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standard. | Bidder requests NTPC to provide width requirement for shoulders? Also whether shoulders are required on both sides of road? | Refer amendment issued separately. |
| 876. | Section VI, Part A,IIA-10 | 7.03.00, d) | 12 of 30 | Pile diameter - 600 mm | NTPC Barh - Being an EPC bid, Owner to allow bidder to select pile diameter, length and capacities as per detailed soil investigation and test pile result. | Bidder shall comply the provisions of technical specification. |

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| 877. | Section VI, Part A,IIA-10 | 7.03.00, b) | 10 of 30 | The maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to values as furnished in Table-2 | NTPC- Barh<br>Bearing pressure values furnished in table-2 are limited to a depth upto 2.5 m below NGL. Bidder understands that for a greater depth greater than 2.5 m, higher bearing pressure, if applicable as per approved soil investigation report shall be permitted. Please confirm bidder's understanding. | Bidder may refer amendment. |
| 878. | General | | | | Owner to furnish AutoCAD Copy of contour survey drawings for all projects. | Owner provides only PDF files |

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| 879. | Section VI, Part B, Subsection IV-D - Civil worksSection VI, Part A, Subsection II - A11Section VI, Part A, Subsection II - 8A | 39.03.003 9.04.007.0 8.00 g)Annexur e-III (New Nabina-gar-I) | 66 of 6966 of 6922 of 2921 of 31 | Fly ash based Portland poz-zolona cement conforming to IS:1489, Part I shall preferably be used....or Fe500D, and con-forming to other requirements of IS:1786Chemicals in ground water as observed during in-vestigation are:.....Cement type - As specified elsewhere in the specification.g)Special re-quirements:Chemicals in ground water as observed dur-ing investigation are:.....In view of the above, the following shall be adopted for all foundations and substructures, | BRBCL and Nabinagar - No separate specification for cement type and re-inforcement steel are mentioned in the relevant subsection. Hence bidder shall follow clause no. 39.03.00 for Cement and clause no.39.04.00 (Subsection IV-D, Section VI, Part B) for Reinforcement steel for projects, wherever special requirements are not mentioned. Please confirm bid-der's understanding. | Bidders's understanding is correct. |

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| 880. | Section VI, Part B, Sub Section - I-M1<br><br>Section VI, Part B, Subsection-IV-D - Civil works | 3.00.00<br><br>3.14.04 | 5 of 51<br><br>13 of 69 | The entire flue gas system, flue gas ducts, absorber etc. shall be designed to meet the following conditions:<br><br>Criteria of flue gas exit velocity for sizing the flue liner material shall be specified elsewhere in the specification. | Owner to specify the below mentioned details for design of 150 m high Chimney:<br>a) Maximum Flue gas exit velocity<br>b) Pressure at Chimney Inlet to be considered by bidder for design.<br>The above mentioned details have not been furnished in tender specification. | **a)** Specification requirement is clear under the referred cl.no. . Bidder shall comply with the specification requirements.<br><br>**b)** To be optimized by the bidder based on its system design and selection. |
| 881. | Errata 1 to Section VI, Part A, Subsection II - A8 | Annexure B | 9 of 31 | a) The basic wind speed "Vb" at ten | NTPC 3x660MWNabinagar - The basic wind speed Vb at ten meters above the mean ground level may please be specified. | The basic wind speed "Vb" at 10m height above the mean ground level for "NABINAGAR-I 3X660 MW" project shall be 47 metres/second. Also refer Amendment issued separately in this regard. |

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| 882. | Section VI, Part A, Subsection IIA6-4 | | Equip-ment layout plan at El 0.00 m | NTPC Solapur - All elevations indicated in the drawing are wrt TG building ground floor elevation as (+/-)0.00 which corresponds to RL(+) 416.5 | NTPC Solapur - Bidder understands that FGL for the plant is RL 461 m whereas TG ground floor level i.e. FFL is RL 461.50. Please confirm. | Bidder's understanding is correct. |
| 883. | Section VI, Part A, Subsection IIA6-4 | 7.00.01 | 9 of 31 | The corresponding bore logs are enclosed at annexure-IV. | NTPC Solapur - Owner to furnish soil investigation report for the vicinity area as the same are not available with tender document. | Bidder to refer amend-ment. |
| 884. | Section VI, Part B, Sub Section - IV-D | 12.00.00 | 31 of 69 | Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for con-struction technique. | As quantum of road work is very less and considering lack of space within the existing units, bidder understands that deployment of mechanical pav-ers are not mandatory. Owner to kindly confirm bidder's understand-ing. | Method(s) as per IRC may be followed. |
| 885. | Section VI, Part B, Sub Section IV D, Civil works | 10.00.00 | 26 of 69 | Site LevellingSite levelling of gypsum area, lime storage ar-ea, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. | Bidder is free to decide FGL based on existing NGL in order to optimize cut-ting and filling quantities. Owner to please confirm. | Site levelling shall be done by Owner as per the levels specified in GLP in tender document.<br>Only site clearance and minor<br>grading is in bidder's |

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| | | | | | | scope. |
| 886. | Section VI, Part A, Subsection II-A4 | Annexure III | 19 of 30 | Employer has carried out geotechnical investigation in vicinity to the proposed area. Logs of representative boreholes for bidder's information in the vicinity of proposed area are enclosed with this Annexure | Geotechnical investigation for Dalipalli Stage-I, 2x800 MW project is not attached along with the tender document. Owner is requested to furnish the same. | Refer amendment issued separately |
| 887. | Section VI, Part B, Sub Section - IV-D | 19.00.00 | 39 of 69 | All steel structures shall be fabricated in factory, transported and erected at site. | Bidder understands that fabrication of silo/hoppers /tanks /absorber shell,etc. can either be fabricated at factory or fabricated at site. In case of site or shop fabrication, field connection will be welded. Please confirm bidder's understanding. | Considering the large dimensions of the said equipment, Bidder's understanding is correct. |

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| 888. | Section VI, Sub-section - IIA-3 | Lara topo-graphic survey | | Topographical survey, Drg No. 9548-999-POC-F-002, Rev 0 | NTPC Lara Super Thermal Power Pro-ject - Finished ground level for the plant are @ RL 203 M and RL 202 M whereas the natural ground levels (reduced levels) as per the topo-graphical survey drawing are in the range of 224-230 M. Owner to please verify whether bidder have received the correct topographical survey drawing for the referred project. | Refer amendment issued separately. |

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| 889. | Section VI, Part B, Sub Section - I-M6<br><br>Section VI, Part A, Sub Section III-A5 | 3.4.0<br><br>2.01.07 | 3 of 73<br><br>3 of 6 | Crushed limestone shall be stored in **covered ground storage sheds using mobile trippers.** The capacity of the storage shed shall be equivalent to limestone consumption for atleast 7 days.....<br>From **reclaim hopper**, crushed limestone of (-) 20 mm size would be fed to limestone bunkers through...<br><br>Crushed limestone Reclaim hopper(RH)/Silo, machinery hatches at each end of limestone storage shed for RH, fully/partially underground or overground junction towers..... | In order to keep all bidders at par, Owner to please clarify the following:<br>a) In case crushed limestone to be stacked under a storage shed with hopper, owner to specify the ratio of underground to overground hopper.<br>b) Owner is also requested to share schematic drawing of the limestone storage shed. | One third (1/3 rd) of total stipulated crushed limestone storage shall be considered in the hopper and hopper length shall be equal to stockpile length placed along the tripper centreline.<br><br>Bidder to refer Amendment in this regard. |

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| 890. | Section VI, Part A, Sub Section III-A5 | 2.01.01 | 2 of 6 | Before existing crusher house of CHP, the unloaded lime-stone will be fed to new lime-stone crusher house through series of new convey-ors/bucket elevators. All nec-essary modifications involving Mechanical, Electrical, Civil and Structural works in the existing CHP for taking feed to new limestone path shall be in the scope of the bidder. | Owner is requested to share the fol-lowing drawings pertaining to Crusher house for all projects:<br>a) GA and elevation drawings of crusher house indicating floor wise equipment layout.<br>b)Foundation drawings for crusher house<br>c)Conveyor profile and layout draw-ings of CHP<br>d)Structural steel drawings of Crusher house<br>e) Design document of Crusher house building | General Layout Plan of the plants is already given in the tender documents. Other drawings like Coal Flow Diagram and Trans-fer Tower GA, if required, shall be provided to suc-cessful bidders. |

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| 891. | Section VI, Part A,SUB SECTION-III-A1, FGDSUB-SECTION-IVTERMINAL POINTS &EXCLUSIONS | 2.06.001.10.00 | 2 of 92 of 3 | Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor (in Employers scope). The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor being provided by the Employer.TERMINAL POINTS:Gypsum Outlet of Gypsum storage silo/shed | There is discrepancy in the referred clauses for the scope of Gypsum handling belt conveyor.Bidder understands that gypsum handling belt conveyor including gypsum storage silos are in bidder's scope in line with referred terminal points.Please confirm bidder's understanding. | Bidders understanding is correct. Refer necessary amendment in this regard. |

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| 892. | Section VI, Part A,SUB-SECTION-III-A5 LIMESTONE & GYPSUM HANDLING PLANTS | 2.01.01 | 2 of 6 | Two (2) numbers Box Feeders/ Bulk-material Receiving Unit/ Underground Truck Unloading Hopper / Surface feeder, for unloading of limestone from trucks/ self tippling trucks/ loader shovels, complete with drives, accessories all mechanical, electrical and C&I, Civil & structural works, including its supporting foundations etc. This unit shall feed limestone onto the conveyor before Limestone crusher house. | Bidder requests Owner to confirm the storage volume as required for hopper at the inlet of surface feeder. | The system shall be designed to handle trucks of 60 MT gross weight. Necessary amendment in this regard shall be issued. |

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| 893. | Section VI, Part A,SUB-SECTION- III-A5 LIMESTONE & GYPSUM HAN-DLING PLANTS | 2.01.01 | 2 of 6 | Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house through series of new con-veyors/bucket elevators. All necessary modifications involving Mechanical, Electrical, C&I, Civil and Structural works in the exist-ing CHP for taking feed to new limestone path shall be in the scope of the bidder.<br>For unloading of Limestone through WT/Track Hopper of the existing Coal Handling Plant, limestone 'Feed Point' before ex-isting CHP's Crusher House. | Owner is requested to furnish the follow-ing to enable bidder to design the lime-stone handling layout:<br><br>1) GA and elevation drawing of existing coal conveyor before existing coal crush-er house<br>2) GA and elevation drawing of existing CHP crusher house.<br>3) GA and elevation drawing of existing Transfer points just before coal crusher house. | General Layout Plan of the plants is already given in the tender documents. Other drawings like Coal Flow Dia-gram and Transfer Tower GA, if required, shall be pro-vided to successful bidders. |
| 894. | Section VI, Part A,SUB-SECTION- III-A5 LIMESTONE & GYPSUM HAN-DLING PLANTS | 2.01.06 | 3 of 6 | Suitable numbers of hammer crusher complete with drives, accessories all mechanical, elec-trical civil & structural works, in-cluding crusher supporting foun-dations, vibration isolation sys-tem with springs and viscous dampers, vibration monitoring system etc. | Owner is requested to allow for im-pact/roll type crusher also as an alterna-tive to hammer mill as there are limited manufactures for such higher capacity ( 1200 TPH) hammer mill. | Technical Specification is clear. Bidder shall comply. |

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| 895. | Section VI, Part A,SUB-SECTION- III-A5LIMESTONE &GYPSUM HANDLINGPLANTS | 2.01.07 | 3 of 6 | Crushed limestone Reclaim Hopper (RH) /Silo, machinery hatches at each of end of limestone storage shed for RH, fully / partially underground or over ground junction towers, tunnels and pent houses, complete with civil, structural, architectural, electrical and C&I works including over ground structural shed for entire length of limestone ground storage and machinery hatches, removable chequered plate covers over openings in machinery hatches for handling underground equipment like paddle feeders etc. (as applicable). For Limestone storage shed and for all buildings, other equipment such as DS system, ventilation system, drinking water system, drainage system etc. as specified elsewhere in the specification. | We understand DS system is not applicable for limestone, kindly clarify. | DS system is not applicable for limestone handling. Necessary amendment shall be issued. |

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| 896. | Section VI, Part A,SUB-SECTION- III-A5 LIMESTONE & GYPSUM HANDLING PLANTS | 2.01.27 | 5 of 6 | One (1) number of belt vulcanizing machine, suitable for all belt widths in limestone handling system, complete with all mechanical, electrical, accessories and consumables for one year of consumption. Further belt jointing facilities as specified shall be provided. | We are considering common belt vulcanizing machine for Limestone and Gypsum handling plant.<br><br>Kindly confirm. | Confirmed. |
| 897. | SUB-SECTION-I-M6 LIMESTONE HANDLING PLANT (LHP) | 4.11.3 | 16 of 73 | ".....vii. Feeder carriage drive shall be suitably designed so that the forward & reverse movement of carriage can be achieved without stopping the scooping operation. Tank filled with water in **DS system** shall also be considered for travel drive. Capacity of tank mounted on tail end side shall be sufficient for half an hour operation....." | As this section deals with Limestone handling, so the DS System is not applicable as Dust extraction system is envisaged for Limestone paddle feeders.<br><br>Pl. clarify & confirm. | Confirmed. |

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| 898. | Section VI, Part A,SUB-SECTION- III-A5 LIMESTONE & GYPSUM HAN-DLING PLANTS | 2.01.23 | 5 of 6 | Complete dust extraction system for control of fugitive dust in limestone storage shed / Silos, junction towers, crusher house complete with fans, drives, hoist-ing arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works. | Bidder understand that DE system below existing CHP track hopper and wagon tipplers is not envisaged for handling limestone dust.<br><br>Please confirm bidder's understanding. | Confirmed. |
| 899. | Section VI, Part A,SUB-SECTION- III-A5 LIMESTONE & GYPSUM HAN-DLING PLANTS | 2.01.19 | 4 of 6 | One (1) number of passenger cum goods elevator with drives, all electrical, mechanical, civil, structural & associated founda-tion works, accessories and electrical to serve various floors of lime stone crusher house. | Bidder requests Owner to confirm the capacity of elevator for limestone crush-er house. | One (1) number conven-tional enclosure type pas-senger cum goods elevator having capacity of 16 per-sons (1088 kg) complying to IS:14665 (latest edition) with drives, all electrical, mechan-ical, civil, structural & associ-ated foundation works, ac-cessories and electrical to serve various floors of lime stone crusher house. Stair-case access for machine room shall also be provided by the bidder. |

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| 900. | Section VI, Part A,SUB-SECTION- III-A5 LIMESTONE & GYPSUM HAN-DLING PLANTS | 2.01.28 | 5 of 6 | Minimum one (1) no. Weighing Bridge for Road trucks / Tipplers shall be provided each in Lime-stone unloading area and in Gyp-sum Loading area. | Bidder requests Owner to confirm the capacity of weigh bridge for limestone unloading and gypsum loading area. | Weigh bridge capacity shall be 100 MT. |
| 901. | Section VI, Part A,SUB-SECTION- III-A5LIMESTONE &GYPSUM HAN-DLINGPLANTS | 3.07.00 | 6 of 6 | Gypsum from storage shed shall be loaded to user's trucks using front end loader/ pay loader. | Whether front end loader/ pay loaders needs to be supplied by bidder or it shall be by NTPC.If yes, then Qty and capacity of front end loader/ payloaders required for gypsum & limestone to be specified. | Technical Specifications is clear. Front end loader/ pay loaders are not in bidder's scope. |

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| 902. | Section VI, Part A,SUB SECTION: III-A4<br>EQUIPMENT COOLING<br>WATER SYSTEM | 1.01.00 | 3 of 3 | EQUIPMENT COOLING WATER SYSTEM<br>(FOR LARA STPP- 2 X 800 MW,**KUDGI-2 X 800** MW,GADARWARA -2 X 800 MW,DARLIPALI-2 X 800 MW,MOUDA –II 2 X 660 MW,TANDA-II -2 X 660 MW,MEJA-2 X 660 MW,)<br><br>3 x 50% (2 working + 1 standby) capacity of plate type heat exchangers. | In case of kudgi project, the plant configuration is 3 x 800 MW. While the configuration stated in referred clause is 2 x 800 MW. Also accordingly the PHE configuration specified for kudgi project is 3 x 50%.<br>Bidder requests NTPC to kindly clarify PHE configuration for 3x800 MW Kudgi project. | Necessary amendement is being issued. |

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| 903. | Section VI, Part A,SUB-SECTION-V SALAIENT DESIGN DATA & SIZING<br><br>SUB-SECTION-I-M6 LIMESTONE HANDLING PLANT (LHP) | 10.08.00<br><br>4.1.6 | 22 of 26<br><br>5 of 73 | Continuous Motor Rating:<br>a) For conveyors of belt conveyor systems *120% of actual power at drive motor output shaft at specified design capacity.<br><br>Rating of all drive motors of conveyors shall not be less than 120% of the power required at drive motor output shaft at specified design capacity. | Bidder proposes to consider the Continuous Motor Rating: as follows:<br><br>a) For conveyors of belt conveyor systems *120 110 % of actual power at drive motor output shaft at specified design capacity in line with NTPC Patratu Project.<br><br>Please confirm your acceptance. | Noted. Bidder may please refer the amendment in this regard. |

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| 904. | Section VI, Part A,SUB-SECTION-V SALAIENT DESIGN DATA & SIZING<br><br>Section VI, Part B, SUB-SECTION-I-M6 LIMESTONE HANDLING PLANT (LHP) | 10.15.00<br><br>4.13.18 | 25 of 26<br><br>20 of 73 | Dust extraction system:<br>Type : Venturi scrubber type<br>Location : Belt feeder after crusher & Vibrating Screening Feeder at crusher house.<br><br>Dust extraction system for Limestone Handling area:<br>Dust extraction system for limestone handling system shall be dry type comprising of dust collection hoods, ducting, fans, bag filter and dust collection hopper. | Due to discrepancy in referred clauses, bidder shall consider the DE system for Limestone as per cl. No. 4.13.18 of Sub Sec-I-M6 of part-B and not as per cl no 10.15.00 of Sub Sec-V of part A.<br><br>Please confirm. | Noted. |

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| 905. | SUB-SECTION- III-A5LIMESTONE & GYPSUM HAN-DLING PLANTSSUB-SECTION-I-M6LIMESTONE HANDLING PLANT(LHP) | 2.01.053.3.0 | 3 of 63 of 73 | Suitable numbers of **vibrating feeders** in limestone crusher house to feed thelimestone to crushers with drives, dust hoods, all mechanical, electrical accesso-ries and supporting structures etc.In limestone crusher house, limestone from each incoming Conveyor shall pass through two (2) numbers of (dedicated) **Vi-brating grizzly/ screening Feed-ers** and two (2) numbers of (dedi-cated) crushers respectively which shall crush limestone to (-) 20mm size or to suit limestone pulverizer and system. | Due to discrepancy in referred clauses, please confirm whether vibrating feeders or vibrating grizzly/screen feeders to be considered for limestone feeding to Crusher. | Vibrating screening feeder shall be considered for lime-stone crusher house. Neces-sary amendment shall be issued. |

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| 906. | SUB-SECTION-I-M6<br>LIMESTONE HANDLING PLANT (LHP)<br><br>SUB-SECTION- III-A5<br>LIMESTONE & GYPSUM HANDLING PLANTS | 4.10.0<br><br>2.01.05 | 14 of 73<br><br>3 of 6 | Vibrating feeder shall be provided below the crusher for limestone.<br><br>Suitable numbers of vibrating feeders in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc. | Due to discrepancy in referred clauses, please confirm the position of vibrating feeder in limestone crusher house. | Clause No.2.01.05 of Sub-section III-A5 shall be followed in this regard. Necessary amendment shall be issued. |
| 907. | SUB-SECTION-I-M6<br>LIMESTONE HANDLING PLANT (LHP) | 4.5.3 | 9 of 73 | Alternatively, Air cooled type scoop coupling is also acceptable for all conveyors with HT motors for (**AHP**, LHP, GHP) and crusher scoop couplings. | Bidder understands that AHP conveyor is not applicable for these FGD tenders.<br><br>Please confirm bidder's understanding. | Confirmed. |

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| 908. | SUB-SECTION-I-M6 LIMESTONE HANDLING PLANT (LHP)<br><br>SUB-SECTION- III-A5 LIMESTONE & GYPSUM HANDLING PLANTS | 4.7.0<br><br>4.8.0<br><br>2.01.14 | 10 of 73<br><br>11 of 73<br><br>4 of 6 | **TRAVELLING TRIPPER AND BUNKER SEALING ARRANGEMENT:** Mobile Trippers on bunker conveyors along with belt sealing arrangement shall be furnished and erected.<br><br>**PLOUGH SYSTEM** (IF APPLICABLE): As an alternate to travelling tripper (Alternate option applicable only for limestone mill bunkers) plough type system may be provided by the bidder.<br><br>**Suitable number of plough**s and its actuating mechanism shall be mounted on each conveyor to feed limestone into limestone mill bunkers.<br>Alternatively, suitable nos. **fixed Trippers** on each conveyor to feed limestone into limestone mill bunkers. | Due to discrepancy in referred clauses, bidder understands that any of the following system can be considered on limestone bunker conveyor.<br>1) Travelling tripper<br>2) Plough System<br>3) Fixed Trippers<br><br>Please confirm bidder's understanding. | Confirmed. |

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| 909. | Section-VI / Part-A / Sub-Section-I | 4.04.024.04 .02.01,4.04. 02.02 | 15 of 19 | **Route-2:**The Bidder/its Sub-vendor who do not meet the qualification requirements stipulated at 4.04.01.01 above, may also participate provided the Bidder/its Sub vendor is a contractor who have designed, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number of Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser) operating in an Industrial unit which should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder and **associates/collaborates with an Associate/Collaborator who in turn fully meets the requirements stipulated at 4.04.01.01 above**.Bidder/its sub vendor should also have a valid ongoing collaboration and technology transfer agreement with an Associate/Collaborator meeting re- | Bidder request owner to modified the proveness criteria for FGD waste as follows:The Bidder/its Sub-vendor who do not meet the qualification requirements stipulated at 4.04.01.01 above, may also participate provided the Bidder/its Sub vendor is a contractor who have designed, supplied, erected/ supervised erection and commissioned/ supervised commissioning at least one (1) number of Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser) operating in an Industrial unit which should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder **and associates/collaborates with an Associate/ Collaborator who in turn fully meets the requirements stipulated at 4.04.01.01 above.**The above changes in proveness criteria is required to avoid monopoly of some vendors who qualify as per **Route-1, cl 4.04.01.01**. | Bidder to refer clarifications being issued separately. |



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| 910. | Section-VI / Part-A / Sub-Section-IV | General | - | TERMINAL POINTS & EXCLUSIONS | Owner to specify the water availability (pressure & terminal point) for HVAC for FGD related scope of work. | |
| 911. | SECTION – VI, PART-A / SUB-SECTION-IV Terminal Points & Exclusions | 1.08.00 | 2 of 3 | FGD waste water pipes shall terminate along with isolation valve at 5 meters near HCSD mixing tank | We presume this is not applicable in Barh & Nabinagar, since ZLD is provided.<br><br>Please clarify. | Bidder's understanding is in order. |
| 912. | Process Flow Diagram / ZLD | | 3 of 3 | | The scheme shows steam driven crystallizer, whereas write up calls for MVR. Please clarify. | As mentioned in Cl. No. 2.00.00 D, Sub-section I-M7, Part-B, Auxiliary steam if required shall be provided by owner for start-up condition only.<br>For continuous duty, Bidder to design the various systems considering power driven equipment and the same shall be considered in power guarantee. |

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| 913. | Section VI, Part B, Sub Section IV D, Civil works | 17.21.00 b) | 37 of 69 | Waterproofing treatment shall be provided for liquid retaining/carrying structures and basement type structures (requiring dry working condition). | Bidder understands that clause no. 17.21.00 of subsection IV-D Civil works, is not applicable for truck hopper and limestone hopper. Please confirm. | Bidder's understanding is correct. |
| 914. | Section VI, Part B, Sub Section IV D, Civil works | 3.01.00 | 3 of 69 | Truck hopper - Chemical injection grouting for inner faces. Polymer modified cementitious coating on earth side face as per the following: | | |
| 915. | SECTION- VI, PART-ASUB SECTION-III-A1FGD | 1.03.00 | 1 of 9 | The FGD system shall have an independent absorber for each unit, common limestone milling systems and common gypsum dewatering system for each Lot 1 A Project. | The space available for installation of FGDs at most sites is very limited. In such cases, it shall be beneficial to optimise the available space when offered technology is capable to do so with equal effectiveness. Bidder offers Jet Bubbling Technology, which has excellent flexible operability even at turndown ratios of 15%. We request NTPC to accept option of offering combined absorber for multiple units. Our collaborator has proven references of such common absorbers installed for multiple units operating successfully globally. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| 916. | SECTION-VI, PART-B/ SUB SECTION-1-M3/COMPRESSED AIR SYSTEM | 2.02.02 | 1 of 7 | The rotor and shaft shall be of single piece construction, made of forged steel (AISI C1141 or equivalent). The stator (casing) shall be of Cast-Iron (IS-210 grade) Construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration. | Bidder would like to clarify that, material of construction of compressors shall be as per manufacturer' s standard design which is proven in the industry.<br><br>Owner is requested to accept the same. | Bidder shall comply with spec-ification requirement. However, any superior mate-rial may be accepted as per manufacturer proven design practice |
| 917. | SECTION-VI, PART-B/ SUB SECTION-1-M3/COMPRESSED AIR SYSTEM | 4.11.00 | 2 of 7 | For the instrument air compres-sors offered with "Heat of com-pression" type air drying plants, the after coolers shall be provid-ed at downstream of Air Drying Plant. | Bidder would like to clarify that, after cooler shall be integral part of compres-sor instead of installing the seperate af-tercooler downstream of air dryer and the hot air required for HOC type dryer regeneration shall be taken from last stage of compressor, before after cooler as per prevailing industry practice.<br><br>Owner is requested to accept the same. | Bidders query is not clear. In HOC type Air dryer, to re-duce the discharge tempera-ture at dryer outlet to 45 deg celcius, after cooler shall be provided at downstream of air dryer as per specification requirement. |

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| 918. | SECTION-VI, PART-B/ SUB SECTION-1-M3/COMPRESSED AIR SYSTEM | 3.04.00 | 2 of 7 | **Compressor frame shall have minimum 10% extra capacity.** Compressor shall have 25% minimum turndown capability (at 45 deg C & 75% RH). Compressor shall be provided with IGV at the suction flange. | Bidder requests owner to relook the additional margin of 10% on compressor capacity in frame size as specified, since the margin of 100% on actual air requirement is already considered in sizing criteria{i.e. **2(A+B+C+D)}**<br><br>Owner is requested to accept the com- | The referred cl. 3.04.00 stands deleted. Bidder to refer relevant amendment. |

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| 919. | SECTION- VI, PART-A / SU B·SECTION·VSALAIENT DESIGNDATA & SIZING | 9.01 .00, a) | 20 of 26 | **Air Compressor**Air Compressor shall be designed to meet the Instrument air and service air requirement of all the equipmentslplant/systems to be supplied by the Contractor for FGD Plant and ZLD plant (if applicable) as follows:-**Sl. No. Continuous Requirement Quantity (in NM3tmin)**1. Instrument air requirement for FGD plant A(Continuous)2. Instrument air requirement for ZLD plant B(Continuous)3. Service air requirement for FGD plant C4. Service air requirement for ZLD plant D5. Total Air requirement = A+B+C+D**6. Capacity of air compressor = 2(A+B+C+D)** | presor without additional margin of 10% on capacity. | The referred cl. 3.04.00 stands deleted. Bidder to refer relevent amendment. |

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| 920. | SECTION-VI, PART-B/ SUB SECTION-1-M3/COMPRESSED AIR SYSTEM | 3.01.00 | 2 of 7 | Air Compressors (screw /**Centrifugal type**) shall be de-signed for continuous operation with high efficiency to satisfy the performance requirement as specified in the Data Specification Sheet. | The air requirement for FGD plant is very less(minimum capacity specified is 15 Nm3/min), hence bidder suggests to pro-vide **screw type or reciprocating type** compressors instead of centrifugal com-pressors.Please note that centrifugal air compressors are not recommened for lower capacities.<br><br>Owner is requested to confirm. | Type of compressor shall be screw type as specified in Section VI, Part A sub section -III-A2.Bidder to refer relev-ent amendment. |
| 921. | SECTION-VI, PART-A/SUB SECTION-II-A10/PROJECT IN-FORMATION/BARH STPP STAGE-I(3X660 MW) | - | 21 OF 30 | CLIMATOLOGICAL TABLE-BARH STPP STAGE-I(3X660 MW) | Owner is requested to furnish the reada-ble version of climatological table, since the text is not clear in table attached with project information. | Specification requirement is clear. Bidder shall comply with the specification re-quirements. |

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| 922. | SECTION- VI, PART-A/ SUB SECTION-III-A2/ AIR CONDITION-ING, VENTILATION SYSTEM & COM-PRESSED AIR SYS-TEM | 1.00.00 (b) | 1 of 4 | **Air Conditioning system for FGD Control room building and ZLD control room building 9if provid-ed)** Air Cooled condensing units (DX type) type air conditioners with AHU of suitable capacity with 100% redundancy (as per actual heat load calculation) shall be provided. | For ZLD control room (if required) if total ac load is of order of 15-25 TR, ductable split / packaged ac shallbe provided as mentioned in silent design data & sizing. Owner to confirm. | noted |

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| 923. | SECTION- VI, PART-A/ SUB SECTION-V/Salaient design data & sizing | 7.01.00 (15) | 11 of 26 | For areas, where a/c load is of the order of 25-60 TR, Direct expansion (D-X) type condensing unit (with AHU) shall be provided depneding on the availabilit of space / layout etc. For areas, where A/C load is of the order of 15-25 TR, ductable split/packaged A/C shall be provided. Smaller areas which area away from the D-X type condensing unit / central chilling units which may required air condining upto 15 TR rating shall be served with Hi-Wall Split / cassette air conditioner units as per requirement. | | noted |

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| 924. | SECTION- VI, PART-A/ SUB SECTION-III-A2/AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM | 2.00.00 (b) | 2 of 4 | **Non A/C areas of FGD Control room building and ZLD control room building 9if provided)** Minimum One (1) no of evaporative type unitary air filtration (UAF) unit (of metalic construction modular type) of suitable capacity with all accessories, DIDW centrifugal fan 91X100%), circulating water pump (1X100%) etc as detailed out in technical specification shall be provided. | Since ZLD Control rbuilding ( non a/c area) less in capacity and heat load, bidder proposed dry ventilation system ZLD control building. Owern to confirm complaince. | Bidder shall comply with specification requirement. However If ZLD buiding is separate building , mechnical ventilation shall be provided. Bidder to refer relevant amendment also in this regard. |
| 925. | SECTION- VI, PART-B/ SUB SECTION-I-M2/AIR CONDITIONING, VENTILATION SYSTEM | 3.01.00 (i) | 1 of 26 | Unitary air filtration (UAF) units of min. capacity 75000 m3/hr or capacity calculated considering 8 air changes per hour whichever is higher, shall be provided for Non-Air conditioned areas of FGD and ZLD (as provided) control building (e.g. switch gear rooms, cable galleries etc.) | Since, Non air conditioned areas of ZLD is smaller in volume and Heat load, Bidder will provided UAF unit as per capacity calculatation according to Design criteria mentioned in technical specification. Owner to confirm compliance. | Bidder to refer relevant amendment in this regard. |

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| 926. | SECTION- VI, PART-B/ SUB SECTION-I-M2/AIR CONDITIONING, VENTILATION SYSTEM | 3.01.00 (ii) | 1 of 26 | Mechanical Ventilation (using roof extractors / supply and /or exhaust fans) shall be provided for various other areas / buildings in the scope of bidder as under.<br>A) Grinding System Building<br>B) Gypsum Dewatering bulding<br>c) Recirulation pump & Oxidataion blower / compressor building. | As per clause no. 3.02.00, Bidder understand that Exhaust air fan and fresh air louvers for following areas / building shall be provided.<br>A) Grinding System Building<br>B) Gypsum Dewatering bulding<br>C) Recirulation pump & Oxidataion blower / compressor building.<br>Owner to confirm bidder understanding. | Specification requirement is amply clear. Accordingly, Mechanical Ventilation (using roof extractors / supply and /or exhaust fans) shall be provided for following building:<br>A) Grinding System Building<br>B) Gypsum Dewatering bulding<br>c) Recirulation pump & Oxidataion blower / compressor building. |
| 927. | SECTION- VI, PART-B/ SUB SECTION-I-M2/AIR CONDITIONING, VENTILATION SYSTEM | 3.02.00 | 1 of 26 | All non air condionied aeas covered under this package shall be ventilated by a combination of supply / exhaust fans and fresh air intake / back draft louvers as detailed below. | | |
| 928. | SECTION- VI, PART-A/ SUB SECTION-III-A2/<br>FIRE DETECTION & PROTECTION SYSTEM | 1.00.00 (1.2 & 1.3) | 1 of 2 | HVW Spray System & MVW Spray System | Owner is rquested to provide Spray pump capacity (flow) for HVWS and MVWS system. | Capacity of spray pump (existing) is 410 cmh and head 105/120 MWC. |

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| 929. | SECTION- VI, PART-A SUB SECTION-III-A1FGD | 1.03.00 | 1 of 9 | The FGD system shall have an independent absorber for each unit, common limestone milling systems and common gypsum dewatering system for each Lot 1 A Project. | The space available for installation of FGDs at most sites is very limited. In such cases, it shall be beneficial to optimise the available space when offered technology is capable to do so with equal effectiveness. Bidder offers Jet Bubbling Technology, which has excellent flexible operability even at turndown ratios of 15%. We request NTPC to accept option of offering combined absorber for multiple units. Our collaborator has proven references of such common absorbers installed for multiple units operating successfully globally. | Bidder shall comply with the Technical Specification requirements. |

| S.No | Clause No | Page No. | Description of Bid Document | Queries/Suggestions | NTPC Clarifications |
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| 930. | DWG No: 360/361-999-POC-F-001 | | General Layout Plan (Meja Thermal Power Project - Stage -I) | The space indicated in the GLP is inadequate for installation of FGD system. Based on Site visit the following space are not yet construction started or open. The same space to be proposed for FGD system<br>1) East side of unit #2 ESP<br>2) East side of ESP Control Room Unit #2<br>3) In-between Gird N 1000 to N 1200 & E 1000 to E 1200d<br>4) South side of the Coal stock pile area in between Grid N00 to N 245 and E650 to E 1150<br>NTPC to review and confirm | Bidder to refer Amended GLP being issued separately. |
| 931. | DWG No: 9562-999-POC-F-001 | | General Layout Plan (Tanda Thermal Power Project- stage -II) | The space indicated in the GLP is inadequate for installation of FGD system. Based on Site visit the following space are not yet constructed or open. The same space to be proposed for FGD system<br>1) West side of ESP ( Including drain and road)<br>2) In-between Gird N 900 to N 1100 & E 580 to E 600<br>NTPC to review and confirm<br>3) Hydrogen generation plant area<br>NTPC to review and confirm | 1. Space for road and drain cannot be used for FGD facilities.<br>2. Area in-between Gird N 900 to N 1100 & E 580 to E 600 is already allocated for erecting CHP workshop, O&M stores and laydown & pre-assembly activities.<br>3. Hydrogen generation plant cannnot be relocated. |

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| 932. | DWG No: 9573-999-POC-F-001 | | General Layout Plan (Kudgi Super Thermal Power Project- stage -I) | The following additional space is proposed for FGD system<br>1) In-between Gird N 2200 to N 2280 & E1700 to E1780<br>NTPC to review and confirm | Bidder to refer Amended GLP being issued separately. |
| 933. | DWG No: 9571-999-POC-F-001 | | General Layout Plan (Solapur Super Thermal Power Project- stage -I) | The following additional space is proposed for FGD system<br>1) In-between Gird N 350 to N 500 & E1200 to E1625<br>NTPC to review and confirm | The space between Gird N 350 to N 500 & E1200 to E1625 has been envisaged for stage-II and can not be used . |
| 934. | DWG No: 9572-999-POC-F-001 | | General Layout Plan (Gadarwara Super Thermal Power Project- stage -I) | The space provided for FGD system installation in the GLP is Inadequate. NTPC to review and explore the same. | Bidder to refer Amended GLP being issued separately. |
| 935. | DWG No: 9543-999-POC-F-001 | | General Layout Plan (Darlipali Super Thermal Power Project- stage -I) | The space indicated in the GLP is inadequate for installation of FGD system, The following additional space is proposed for FGD system<br>1) In-between Gird N 10050 to N 10400 & E7450 to E7650<br>NTPC to review and confirm | The space between Gird N 350 to N 500 & E1200 to E1625 has been envisaged for stage-II and can not be used. |
| 936. | DWG No: 9561/9575-999-POC-F-001 | | General Layout Plan (Mauda Super Thermal Power Project- stage -I) | The space indicated in the GLP is inadequate for installation of FGD system, The following additional space is proposed for FGD system<br>1) North-West direction Ash silo<br>NTPC to review and confirm | Bidder to refer Amended GLP being issued separately. |

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| 937. | DWG No: 0270-999-POC-F-001 | | General Layout Plan (Nabinagar BRBCL Thermal Power Project) | The following additional space is proposed for FGD system1) In-between Gird N 1500 to N 1449 & W 600 to W 750NTPC to review and confirm | Bidder to refer Amended GLP being issued separately. |
| 938. | DWG No: 0370-999-POC-F-001 | | General Layout Plan (Nabinagar Thermal Power Project) | The following additional space is proposed for FGD system<br>1) In-between Gird N 1790 to N 1515 & E 1523 to E 1470<br>NTPC to review and confirm<br>2) In-between Gird N 2000 to N 1500 & E 2100 to E 1900<br>NTPC to review and confirm<br>3) In-between Gird N 1520 to N 1550 & E 1390 to E 1285<br>NTPC to review and confirm.<br>4) In-between Gird N 1520 to N 1550 & E 1200 to E 1270<br>NTPC to review and confirm.<br>5) In-between Gird N 1490 to N 1357 & E 1920 to E 2100<br>NTPC to review and confirm.<br>6) North side of Unit#1 (parallel to ESP and chim-ney) NTPC to review and confirm<br>7) South side of ESP unit#3.<br>NTPC to review and confirm | Bidder to refer Amended GLP being issued separately. |

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| 939. | DWG No:9558/9560-999-POC-F-001 | | General Layout Plan (Barh Thermal Power Project) | The space provided for FGD system installation in the GLP is Inadequate. NTPC to review and explore the same. | Bidder to refer the revised GLP in issued amendments. |
| 940. | | | General | For develop the duct routing NTPC is requested to furnish the Elevation drawing for the following facilities<br>1) TAC House<br>2) HCSD Pump House<br>3) HCSD Silos<br>4) Transformer<br>5) ASPH<br>6) AWPH<br>7) Switch gear room<br>8) ESP Control room | Bidder to refer the revised GLP in issued amendments. |
| 941. | | | General | It is found that the GLPs provided in the tender document is not in line with "as built drawings".<br><br>NTPC is requested to furnish the as built drawings for all the projects. | Bidder to refer the revised GLP in issued amendments. |

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| 942. | Section-VI, Part-B, Sub Section-I-M1 | 15 of 51 | Head : For Spray tower Process actual requirement considering Choking/Blocakge of minimum 10% of the oxidation nozzles/Sparayers or minimum 8500mmwc whichever is higher | As per QFGDM technology requirment of maximum liquid level in the absorber is such that after considering all margins head requirment of the oxidation blower is much less than 8500mmwc. Threfore NTPC is requested to relax this criteria of minimum head of 8500mm. | Bidder shall comply with the requirements of Technical Specifications. |

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| 943. | Part B/I/M Clause 5.01.00/ Page 14 | Alternatively, the contractor may offer a spare spray level with each spray level served by an independent 100% capacity pump. | Is it one spare spray level or spray levels with the same number of spray levels in service? | Specification requirement is clear under the referred cl.no. 5.01.00. Bidder shall comply with the specification requirements. |
| 944. | Part B/I/M Clause 7.07.07/Page 28 | Contractor shall provide the complete lime doing system to correct the pH of the waste water by lime dosing. | What is the desired pH for wastewater? Is there any other parameter set for wastewater? | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 945. | Part B/I/M Clause 7.08.01/Page 29 | It should be possible to discharge the each absorber into the emergency drain tank within 2 hours. | Is the emergency drain tank the same thing as the auxiliary absorbent tank? | Bidder's understanding is correct. |
| 946. | | | Please clearly show the boundary of available FGD area. | Bidder to refer the revised GLP in issued amendments. |
| 947. | | | Can we make optimized plan of valves which will be different from the PID? | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 948. | | | Please offer CAD and Word documents of all necessary files. | Only PDF provided. |
| 949. | | | Please confirm whether some of the slurry tanks can be anti-corrosion protected with rubber lining. | Specification requirement is clear. Bidder shall comply with |

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| | | | Whether there is standard for the thickness of rubber lining. Also please confirm anti-corrosion material for the absorber. | the specification requirements. |
| 950. | | | Please confirm the number of filtrate water tanks for 3×660MW FGD system. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 951. | | | Please confirm the number and the capacity of oxidation air fans for 3×660MW FGD system. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 952. | | | Please confirm the number of process water tanks for 3×660MW FGD system, also with the number and the capacity of each process water pump. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 953. | | | Please confirm if the fire water pressure does not meet the requirements, the pressurization system is not within the scope of the contract. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 954. | | | Please confirm whether clean flue gas after absorber will return back to the chimney that is already existing or discharge through the wet stack provided by the bidder. And if the condensate col- | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | | | lected could be reused in FGD system, there is no need to build condensate tank and other related equipment. Furthermore, if the wet stack is built on the absorber, 150 meters height will be the total height including the absorber. | |
| 955. | | | Please provide the preliminary geo-technical investigation report. | Bidder to refer amendment. |
| 956. | | | Please provide the topographic map of the area. | Topographic survey drawing already furnished with tender document |
| 957. | TECHNICAL SPECIFICATIONS SECTION-VI,PART-A BID DOC NO:CS-0011-109(1A)-2,PAGE 2 OF 6 | 1.08.00 CABLING | If the cable tray between employers scope equipment and contractors scope equipment should be designed ,supplied and installed by employers. | Bidder understanding is not correct. Refer to the clause no:- 1.08.00.2 and comply with technical specification requirement |
| 958. | TECHNICAL SPECIFICATIONS SECTION-VI,PART-A BID DOC NO:CS-0011-109(1A)-2,PAGE 3 OF 6 | 1.09.00 LIGHTING | Whether the employers have a requirement for the brand of LED lighting. | Technical Specifications are clear and Bidder shall comply with technical specifications requirement |
| 959. | TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2PAGE 6 OF 7 | D.C. Systems | Which kind of DC voltage will be supplied by employers,220V or 110V? | 220V |
| 960. | TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011- | 1.00.00 GENERAL | If the employer will provide the 11KV power source and 3.3kv power source for FGD system? Could the employer provide the security power | Bidders query is not clear regarding security Power source for FGD system. |

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| | 109(1A)-2，PAGE 1 OF 7 | | source for FGD system. | Owner shall provide power to contractor at 11/6.6kV as per Amendment 1 to Tender SLD. |
| 961. | TECHNICAL SPECIFICATION SECTION-VI, PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS PAGE 22 OF 34 | Continuous Emission Monitoring system consisting of the following equipments (Analysers/monitors) shall be provided for measurement of emissions in stack of each unit:-<br>SO2/NOx Analyser<br>CO analyser<br>CO2 analyser<br>Flue gas Flow Meter<br>Flue gas temperature measurement( As defined under Particulate Emission Analyser)<br>Particulate Emission (Stack Opacity) Analyser<br>Mercury Analyser | Bidder has indicated 7 (SEVEN) sets of CEMS ONLY 7 (SEVEN) sets in stack of each unit in the drawing and indicated, no sets at flue gas inlet and no one at flue gas outlet in the drawing.<br><br>Please confirm. | Bidder's query is not clear. However bidder to refer tender drawing no. 0011-109-POM-A-001 for minimum quantity of instrumentation to be provided in FGD inlet and outlet ducts. |
| 962. | TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2 SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM PAGE 1 OF 27 | Contractor shall provide independent control systems for safe, efficient and reliable operation of each of the plant auxiliary systems. The type of control system shall be as indicated under scope part at III C, Part-A, Section VI | Confirmation Required:<br>Please provide the system of the PLC brand, model and control scheme of the network; the engineer station/operator station and printer of PLC system, whether to need to separate configuration, if necessary, please provide brand and quantity<br><br>Please confirm. | Bidder to refer PLC configuration tender drg. No. 0000-151-POI-A-013. The make and model of PLC shall be NTPC QA approved. |

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| 963. | TECHNICAL SPECIFICATION | | Bidder to note that CCTV is not included in this package and hence not to be provided by bidder.<br><br>Please confirm. | Bidder's understanding is correct. |
| 964. | | Bidder Offer: Bidder has indicated All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalization for Employer's review and approval | Confirmation Required: Bidder to note that technical manuals, reference manuals, user's guide etc shall be finalized during detail engineering as per the approved P&ID and specification requirement, hence bidder to confirm that all instruments shall be supplied as per the approved P&ID and control write-up without any cost implication to Owner.<br><br>Please confirm. | Bidder's query is not clear. Bidder shall comply with clause 12.01.00, PART-B, Sub Section IIIC-5 of technical specification. |
| 965. | TECHNICAL SPECIFICATION<br>SECTION-VI, PART-B<br>BID DOCUMENT NO.: CS-0011-109(1A)-2<br>SUB-SECTION-III-C1<br>BASIC DESIGN CRITERIA<br>PAGE 3 OF 4 | Bidder Offer: Further, flue gas desulphurization system, link shall be provided for collection of data in the DDCMIS (In Employer's Scope) in UCR for the information of unit-incharge / shift-incharge etc. through Station Wide LAN. | Confirmation Required: Bidder to note the supply scope of the collection of data in the DDCMIS (In Employer's Scope) in UCR for the information of unit-incharge<br><br>Please confirm. | It is clarified that bidder shall provide a link for collection of data in the DDCMIS (In Employer's Scope) in UCR for the information of unit-incharge / shift-incharge etc. through Station Wide LAN. Bidder shall comply with the specification requirement. |
| 966. | TECHNICAL SPECIFICATION | Bidder Offer: Bidder shall include | Confirmation Required: Bidder has indicated "pro- | Bidder's query is not clear. |

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| | SECTION-VI, PART-B<br>BID DOCUMENT NO.: CS-0011-109(1A)-2<br>SUB-SECTION-III-C1<br>BASIC DESIGN CRITERIA<br>PAGE 1 OF 4 | in his bid a detailed Bill of Material (BOM) for each of the systems. | vided during detail engineering' against most to the requirement. In view of the same, it is found that bidder filled datasheet is preliminary and incomplete.<br><br>Please confirm. | However, Bidder shall comply with the specification requirement. |
| 967. | ECHNICAL SPECIFICATION SECTION-VI, PART-B<br>BID DOCUMENT NO.:CS-0011-109(1A)-2<br>SUB-SECTION-III-C4 INSTRUMENTATION CABLES<br>PAGE 1 OF 13 | Bidder Offer: The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification. | Bidder Offer: Bidder has indicated different types of cables and cable trays in the offer.<br><br>Confirmation Required: Bidder to note the type and length of cable, cable trays shall be finalized during detail engineering as per the routing and system requirement.<br><br>In view of above bidder to note that all cables, cable trays shall be supplied "on as required basis" as per actual site requirement without any cost implication to Owner. Further bidder shall comply to the cable specification requirement.<br><br>Please confirm. | Bidder's query is not clear. However, Bidder shall comply with the specification requirement. |
| 968. | TECHNICAL SPECIFICATION SECTION-VI, PART-B<br>BID DOCUMENT NO.: CS-0011-109(1)-2<br>SUB-SECTION-III-C2 MEASURING INSTRUMENTS<br>PAGE 1 OF 34 | Confirmation Required: Bidder to note that indicated the Instruments are not correct. Bidder to include the following in the offer:<br><br>1、Instruments shall be provided with wetted parts (e.g. diaphragm | Please confirm. | Bidder's query is not clear. However, Bidder shall comply with the specification requirement. |

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| | | seal, etc.) made of Tantalum<br>2、For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments<br>3、 All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor) | | |
| 969. | | | Please provide the preliminary geo-technical investigation report. | Bidder may refer Errata 1 A8 Rev.1 project information chapter. |
| 970. | | | Please provide the topographic map of the area. | Refer amendment issued separately. |
| 971. | | | | |
| 972. | SCOPE OF SUPPLY & SERVICES | 1.06.00 P34<br>Limestone shall be supplied by the Employer. | Please clarify that the expense of water, power, and compressed air consumed during Commissioning & PG testing should be borne by contactor or by purchaser. Whether the limestone should supplied by employer during Commissioning & PG testing. | Specification requirement is clear at clno 1.06.00 . Bidder shall comply with the specification requirements. |
| 973. | | | Whether need to erect a chemical laboratory for | Bidder shall comply with the |

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| | | | Daily operation, and which part shall supply the related tools and chemicals before Acceptance. | specification requirements. |

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| No. | The original | Clarification | NTPC Clarifications |
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| 975. | PDF format | Please provide tender document in word format. | Only PDF provided. |
| 976. | Part A:<br>National and international codes and standard, especially the Indian statutory regulations | Which codes and standard should be adopted for manufacturing all the equipment used in FGD plant? | Bidder shall comply with the specification requirements. |
| 977. | | What is the spare capacity(KVA) of the 11KV transformer? How many stages does the 11KV transformer have? How many voltage switchgear spare locations can be used? | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 978. | | What is the spare capacity(KVA) of the 3.3KV transformer? How many stages does the 3.3KV transformer have? How many voltage switchgear spare locations can be used? | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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|---|---|---|---|
| 979. | | What is the spare capacity(KVA) of the emergency MCC section? How many stages does it have? How many voltage switchgear spare locations can be used? | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 980. | PART-B-I-MECH:<br>Three stage chevron type Mist Eliminators (ME) made of polysulfone or stainless steel shall be provided at the exit of the absorber | According our patent technology "Centrifugal technology" is able to replace the two-stage mist eliminators and to meet the owner's requirements. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 981. | Pate E:<br>All variations shall be clearly brought out in the technical deviation schedule with implications | Due to the time limits, is it possible that we only bring out the main variations? | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 982. | PART-B-I-MECH:<br>The contractor shall provide evaporative | Could you accept other zero liquid discharge process? | Bidder's Query is not clear. Bidder has not provided any detail about his zero liquid discharge process. |

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| | concentration process for FGD<br>Wastewater Treatment Plant to achieve zero liquid discharge (ZLD) | | |
| 983. | PART-A:<br>The Contractor, shall take into account the entire characteristics of expected<br>combination of fuels to be fired, for the complete load range of operation and the<br>expected numbers of Steam Generator start-ups while designing the Chimney flue<br>liner considering Steam Generator in operation both with & without FGD system in<br>operation. The chimney flue liner cladding shall be made of 2 mm thick Titanium<br>(Grade 2 as per ASME SB265) or C-276 alloy | Please provide the drawing of the existing stack. | Same will be provided/discussed with the successful bidder. |

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| | over 8 mm thick (minimum) mild steel<br>base metal of flue liner. Cladding shall be done to achieve the required quality as<br>per ASTM B 898-11. External surface of chimney flue liner projecting over the<br>chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over<br>insulation. The wet stack shall be designed as per the guidelines of EPRI Revised<br>Wet Stack Design Guide . | | |

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| 984. | | | | | | Please provide the layout of each power plant in CAD format in the tender files | Only PDF provided. |
| 985. | | | | | | Please provide the data sheets in word format for edit. | Only PDF provided. |
| 986. | | | | | | Please provide the editable version of the PDF of the tender files, it will be convenient for us to copy word from tender files. | Only PDF provided. |
| 987. | | | | | | Please provide the analysis of the process water of each power plant, especially the concentration of the Cl- in the water. It is extremely important for FGD design | Bidder to refer Design water analysis provided in the Technical specification. |
| 988. | | | | | | Please provide primary geological survey for each power plant, such as geological survey of BTG part. | Bidder to refer necessary amendment in this regard. |

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| 989. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 12 of 51 | 4.07.00 | **(a) Model of operation, ii) one fan (one stream in operation)** | Does it mean that one BUF of each unit is standby and the other is in operation? Please givs us the exact description. | Specification requirement is clear under the referred cl.no. 4.01.01 . Bidder shall comply with the specification requirements. |
| 990. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 13 of 51 | 4.08.00 | The fan shall be suitable for parallel operation and sharing the load capacity over the entire range of operation without hunting. Pulsation shall be avoided by suitable densign of fan and | Last sentence seems to be uncompleted. Please clarify detail description or requirement. | Specification requirement is clear. . Bidder shall comply with the specification requirements. |

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| 991. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 15 of 51 | 5.03.02 | For spray tower process actual requirement considering choking /blockage of minimum 10% of the oxidation nozzles/sprayers or minimum 8500 mmwc whichever is higher. | We are using large size pipe as oxidation nozzle, our diameter can reach 100mm, it is not likely for our pipe to get choked. And since we have only 4-5 nozzles according to absorber agitators. we request that no margin of oxidation nozzle considered for large size oxidation pipe. | Specification requirement is clear under the referred cl.no. 5.03.02 . Bidder shall comply with the specification requirements. |
| 992. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 17 of 51 | 5.06.06 | three stage chevron type Mist Eliminators (ME) made of ploysulfone or stainless steel shall be provided at the exit of the absorber | We suggest that PP instead ploysulfone or stainless steel be used. PP is widely applied in China as MOC of ME. Currently no vendor can provide ME with ploysulfone or stainless steel. | Bidder shall comply with the requirements of the Technical Specifications. |

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| 993. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 19 of 51 | 5.06.11 | the absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining/cladding/wall paper if Alloy C276/Alloy 59 or better material. | We suggest that 4mm rubber lining instead alloy C276/Alloy 59 be used. 4mm rubber lining is widely applied in China as lining of absorber. | Bidder shall comply with the requirements of the Technical Specifications. |
| 994. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 19 of 51 | 5.06.13 | All internal members shall be lined with minimum 2 mm Alloy 59/C276 | We suggest that 2mm rubber lining instead alloy C276/Alloy 59 be used. 2mm rubber lining is widely applied in China as lining of internal members. | Bidder shall comply with the requirements of the Technical Specifications. |
| 995. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 19 of 51 | 5.06.14 | The absorber wet-dry interface shall be made of solid Alloy 59 or C276 of minimum 6 mm thickness | We suggest that carbon steel with 2mm C276 lining instead alloy C276/Alloy 59 be used. 2mm C276 lining is sufficient for wet-dry interface, solid alloy 59 or C276 would cost a lot of money | Bidder shall comply with the requirements of the Technical Specifications. |

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| 996. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 19 of 51 | 5.06.15 | the other bridges (supports) shall be lined with minimum 2 mm Alloy 59/C276. | We suggest that 2mm rubber lining instead alloy C276/Alloy 59 be used. 2mm rubber lining is widely applied in China as lining of supports. | Bidder shall comply with the requirements of the Technical Specifications. |
| 997. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 22 of 51 | 6.05.01 | (ii) Flow 110% of limestone requirement of two absorbers at design point | This is the common rule for all the projects. But different power plants have different Nos. of units. Like Barh has 3×660MW units, so how could we set the capacity of the wet ball mill? | Bidder shall size the wet ball mill based on the 110% of limestone requirement of all the units at design point. |
| 998. | SECTION-VI-PART-A | SUBSECTION - V | 22 OF 26 | 10.07.00 | 1) Crushers 2x50% or 1x100% | How many hrs does a crusher operate one day? Please define 100% capacity for each crusher | Specification requirement is clear under the referred cl.no. 10.07.00 . Bidder shall comply with the specification requirements. |

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| 999. | SECTION-VI-PART-B | SUBSECTION-I-M1 | 29 of 51 | 7.08.01 | It should be possible to discharge the each absorber into the emergengcy drain tank within 2 hours. | Actually it's impossible to achieve the requirement, because the slurry discharge pipe is above ground and the remaining slurry would be first discharged to sump, and then discharged to emergency tank. We suggest that most of slurry in absorber be discharged to emergency tank in 2 hours and the remaining be discharged to emergency tank through sump pump in another 2 hours. | Bidder shall comply with the requirements of the Technical Specifications. |

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| 1000 | Amendment No.1 to Section VI | Part A | 1 of 1 | 1.01.01 | Government of India has launched "Make in India" initiative to transform India into aglobal design and manufacturing hub.Accordingly, to promote manufacturingwithin India, the import content in Flue Gas Desulphurisation (FGD) System package has been restricted to 30% of the total Supply value quoted by Bidder in Price Schedule-1 plus Schedule-2 Bidder shall ensure that it does not import more than 30% of its Supplies and shall manufacture/source equipmenUcomponents from within India to meet the aforesaid requirement. | please clarify detail requirment about this term. if import value proposed more than 30% of Price Schedule-1 plus Schedule-2 will be rejected or still be acceptable but will evaluate the price seperately with other policy? | Bidder to refer clarifications being issued separately. |

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| | **Technical part** | | | | |
| | **Process** | | | | |
| 1001. | 3,5 | PART A SUB-SECTION-V | <table><tr><td>CLAUSE NO.</td><td>SALIENT DESIGN DATA</td></tr><tr><td>2.00.00</td><td>The Flue Gas Desulphurisation (FGD) System FOR MOUDA-II 2X660 MW, TANDA-II 2X660 MW, NABINAGAR-I 3X660 MW, MEJA-I 2X660 MW & BARH-I 3X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:</td></tr><tr><td>CLAUSE NO.</td><td>SALIENT DESIGN DATA</td></tr><tr><td>3.00.00</td><td>The Flue Gas Desulphurisation (FGD) System for SOLAPUR-II 2X660 MW & MEJA-I 2X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below:</td></tr></table> | For the Meja-I power plant, the condition at two places in the tender documents is different, i.e. flue gas volume and sulfur content is different, please specify which one we should comply with. | Refer necessary amendment in this regard. |
| 1002. | | | **Capacity**<br>Stage-I : 3 x 660 MW - Under Construction -Present proposal<br>Stage-II : 2 x 660 MW - Under Operation 图1<br>**Capacity**<br>Stage-I : 2 x 800 MW - Present proposal<br>Stage-II : 2 x 800 MW - In Future 图2 | 1. For the unit which is already under operation (Figure 1 stage-II), whether the desulfurization system has been installed. If so, whether the common utility of the new build de- | Bidder shall comply with the requirements of Technical Specifications. |

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| | | | | sulphurization utility can be combined with that of operating unit?<br>2. For the units that have not yet been built (see Figure 2 stage-II), whether the new desulphurization system needs to consider the reserved space and capacity?<br>The rest of the project is similar | |
| 1003. | 8 | PART A SUB-SECTION-V | 5.00.00 **Chimney**<br>**5.01.00** A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfu (FGD) system by the Contractor. Clean gas from the absorber shall be take Chimney through three stage mist eliminators. Treated flue gas from the a shall be discharged through a wet stack without reheating of the flue gas. | 1. Please clarify that the wet chimney is based on the original chimney for retrofitting or create a new chimney. (But the original chimney has clearly | New wet chimney is in the scope of the Contractor. Location of wet chimney is to be decided by the Bidder based on his layout. |

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| | | | | specified that it belongs to the scope of the contractor)<br>2. If the new chimney is needed, please specify the location of wet chimney (whether built at the top of the absorption tower) and height. | |
| 1004. | 9 | PART A SUB-SECTION-III-A1 | 25.00.00 **Wet Stack Condensate Collection System**<br>25.00.01 Wet stack of 150 metre height shall be provided with a stack condensate collection system to avoid the carryover of the condensate/acidic dews/water droplets/Gypsum coming out of the stack. Design of the wet stack condensate system should be such that all the condensate are collected in the stack itself and no water droplet/condensate come out of the chimney and preventing falling of the acidic dews/water droplet/gypsum from the chimney in the plant/nearby area. | Please explain why the 150m wet chimney requires a condensate system, based on our experience, all the wet stack need condensate system, no matter what the wet stack height is. | Bidder shall comply with the requirements of Technical Specifications. |
| 1005. | 1 | PART A SUB-SECTION-III-A6 | **FGD WASTE WATER TREATMENT (FGD WWT) SYSTEM FOR ZLD**<br>**1.00.00 General**<br>1.00.01 A FGD Waste Water Treatment (FGD WWT) System for Zero Liquid Discharge (ZLD) shall be provided by the Contractor for storing, treating and re-using all wastewaters generated from Wet Limestone based FGD system for Barh STPP St.-I (3x660MW) and Nabinagar TPP (4x250 MW) Units. The contractor shall provide evaporative concentration process for FGD | Please clarify whether wastewater after treatment can be concentrated and cooling sprayed before entering the ESP | Bidder shall comply with the requirements of Technical Specifications. |

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| | | | | duct so that water can be also fully utilized. | |
| 1006. | 2 | PART A SUB-SECTION-III-A5 | 2.00.0 **DETAILED SCOPE**<br>2.01.00 **Limestone Handling Plant (LHP)**<br>2.01.01 Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes. | Please clarify whether the limestone crusher is built at the discharge site or integrated with the limestone slurry preparation system. | Same will be discussed during post bid discussions after submission of techno-commercial bid. |

| S.No | Volume / Section | Clause No. | Page No. | Description / Tender specification | Bidder comments / Deviations | NTPC Clarifications |
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| 1007. | TECHNICAL SPECIFICATION<br>SECTION – VI, PART-A / SUB SECTION-III-A1<br>FGD | 5.03.00 | Page 5 of 9 | This system shall be comprising of 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the unit's operating simultaneously at Design Point, with any range of limestone specified | 2 x 100% (1W + 1S) vacuum belt filter shall be considered for this project. Each belt filter shall be designed to meet the requirement of gypsum produced from all unit of one project. Please confirm | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the referred cl.no. 5.03.00. |
| 1008. | TECHNICAL SPECIFICATION<br>SECTION – VI, PART-A / SUB SECTION-III-A1 | 5.05.00 | Page 5 of 9 | The overflow from the primary set of hydro-cyclone shall be taken to a common Secondary hydro cyclone feed tank | Secondary Hydrocyclone is not foreseen as the installation of a lamella separator is required to remove the high amount of inert material and transport it to | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the referred cl.no. 5.05.00. |

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| | FGD | | | | the waste water treatment plan. There is not foreseen any feed tank but the overflow from the primary set will be taken directly to the lamella separator | |
| 1009. | TECHNICAL SPECIFICATION SECTION – VI, PART-A / SUB SECTION-III-A1 FGD | 5.05.00 | Page 5 of 9 | 2x100% Secondary hydro cyclone pumps shall be provided to feed 2x100% secondary hydro-cyclones | 2 x 100% (1W+ 1S) lamella separators have been considered. Each lamella separator is capable of handling waste water produced from all units of one project. | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the referred cl.no. 5.05.00. |
| 1010. | TECHNICAL SPECIFICATION SECTION – VI, PART-A / SUB SECTION-III-A1 FGD | 5.04.00 | Page 5 of 9 | 2x100% pump shall be provided to supply wash water (for cake washing as well as belt cloth washing) to the belt filters | Filtrate from VBF shall be taken for the cake washing. And for cloth washing clarified water provided by client shall be considered | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the referred cl.no. 5.04.00. |
| 1011. | PID No. 0011-109-POM-A-003 Rev No A | | | | | |
| 1012. | TECHNICAL SPECIFICATION SECTION-VI, PART-A / SUB-SECTION-V SALIENT DESIGN DATA & SIZING | 7 | Page 1 of 26 | Flue gas Analysis for design case Percentage of H2O (v/v) | This value seems to be wrong. Please clarify | Bidder to refer necessary amendment in this regard. |
| 1013. | TECHNICAL SPECIFICATION SECTION-VI, PART-A / SUB-SECTION-V | 7 | Page 1 of 26 | (vi) Inlet SO2 (mg/Nm3-wet) 1915 | Bidder request client to confirm that the value furnished here either for actual $O_2$ or 6% $O_2$ | Specification requirement is clear under the referred cl.no. 2.00.00 . Bidder shall comply with the specification require- |

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| | SALIENT DESIGN DATA & SIZING | | | | | ments. |
| 1014. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 1.03.08 | Page 3 of 51 | In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, flue gas damper upstream & downstream of FGD, Process water pump & lube oil system of Booster Fan & Ball Mill) which may cause irreversible damage to the FGD System shall be connected to the emergency power supply system to be provided by the Contractor | The agitators in absorber are not necessary connect to the emergency power supply | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the referred cl.no. 1.03.08. |
| 1015. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 3.02.04 | Page 6 of 51 | The duct from Absorber outlet to bypass duct shall be made of Carbon steel of minimum 7mm thickness with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material | Bidder is having good experience with glass flake lining in clean gas duct. Client shall accept glass flake lining in clean gas duct. | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the referred cl.no. 3.02.04. |
| 1016. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.01.00 (A) (iv) | Page 14 of 51 | The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side | Bidders having very good experience with butterfly type. Body and other parts which are in contact with slurry shall be lined to provide better life time. | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the referred cl.no. 5.01.00. |
| 1017. | TECHNICAL SPECIFICATION | 5.02.00 | Page 15 of 51 | the contractor shall offer and demonstrate mixing arrangement | Absorber can be operated intermittently with N-1 numbers | Specification requirement is clear in this regards. Bidder shall |

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| | SECTION-VI / PART-B SUB-SECTION-I-M1 | | | such that n-1 number of agitators are sufficient to avoid the slurry settlement in the absorber tank in case of one agitator under break-down | of agitators without compromis-ing the performance of the plant. | comply with the specification requirements under the re-ferred cl.no. 5.02.00. |
| 1018. | TECHNICAL SPECIFI-CATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.06.02 | Page 17 of 51 | Homogeneity shall be ensured, if the deviation from average is less than +10% | Homogeneity shall be less than +/- 30% | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the re-ferred cl.no. 5.06.02. |
| 1019. | TECHNICAL SPECIFI-CATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.06.03 | Page 17 of 51 | Inaccessible gaps or hollow beams shall be avoided | Support beams of absorber shall be lined with rubber. Other type/section of beams with sharp inside edges can't be lined effectively and will get corroded frequently. To avoid this bidder provides the hollow beams to support internal. | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the re-ferred cl.no. 5.06.13 & 5.06.15. |
| 1020. | TECHNICAL SPECIFI-CATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.06.06 | Page 17 of 51 | Three stage chevron type Mist Eliminators (ME) made of polysul-fone or stainless steel shall be pro-vided at the exit of the absorber | We use ME made of PP (Poly-propylene). This material is proved and shows best results | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the re-ferred cl.no. 5.06.06. |
| 1021. | TECHNICAL SPECIFI-CATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.06.06 | Page 18 of 51 | The headroom shall have a height of more than 2200 mm. | Please confirm and clarify the head room required. | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements. |
| 1022. | TECHNICAL SPECIFI-CATION SECTION-VI / PART-B | 14.16.0 0 | Page 36 of 51 | Minimum Headroom (free height) under all floors, ducts, walkways and stairs shall be 2.50 M | | |

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| | SUB-SECTION-I-M1 | | | | | |
| 1023. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.06.10 | Page 19 of 51 | The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as well as intermittently | Continuous operation of inlet flushing is not possible because of water balance in the absorber. | Bidder shall comply with the specification requirements under the referred cl.no. 5.06.10. |
| 1024. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.06.11 | Page 19 of 51 | The absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material | Absorber oxidation tank and tower are all with one single scrubber construction. Most feasible solution is to have rubber lining inside carbon steel shell for complete absorber vessel including oxidation tank. And also internal members of absorber shall also be lined with rubber. Please confirm | Bidder shall comply with the specification requirements under the referred cl.no. 5.06.11. |
| 1025. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.06.13 | Page 19 of 51 | All internal members shall be lined with minimum 2 mm Alloy 59/ C276. All metallic fasteners which are provided inside the absorber/absorber wet-dry interface ducting shall be of Alloy 59/ C276 | | Bidder shall comply with the specification requirements under the referred cl.no. 5.06.13 & also under the referred cl.no. 5.06.15. |
| 1026. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 5.06.18 | Page 20 of 51 | A flushing device of the spray levels with water shall be installed. Flushing shall take place if spray levels are out of operation | A flushing device is installed at the recirculation pipe. This will also flush the spray bank after shut down | NTPC NOTED. |
| 1027. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 8.06.00 | Page 30 of 51 | All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled | Silicon carbide shall also be accepted for all slurry pumps, not only for recirculation pumps. | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the re- |

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| | | | | | | ferred cl.no. 8.06.00. |
| 1028. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 12.02.00 | Page 33 of 51 | The Contractor can provide slurry pipes of size lower than 3" made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same | FRP pipes will be used from 1" up to larger diameters including recirculation pipes. Slurry exposed surface is protected by pure resin layer of 2 mm thickness. | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements under the referred cl.no. 12.02.00. |
| 1029. | TECHNICAL SPECIFICATION SECTION-VI / PART-B SUB-SECTION-I-M1 | 1.03.06 | Page 3 of 51 | The FGD and the ancillary facilities shall be suitable for unlimited operation with all transients and at any load point between the minimum and maximum load point of the Steam Generator | Absorber shall be designed for the salient data of tender specification. And other minimum load cases are not found in the tender documents. Bidder request client to provide flue gas parameter for all load cases to check | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1030. | PID No. 0011-109-POM-A-003 Rev No A | | | | Seal water for vacuum pump shall be from clarified water. Because chlorine content present in filtrate water will be very high. For optimum design, clarified water shall be used as seal water of vacuum pump | NTPC noted. |
| 1031. | PID No. 0011-109-POM-A-001 (a) Rev No A | | | | Recirculation line from the outlet of gypsum bleed pump again back to absorber is not required. Recirculation shall be switched on when the required density of gypsum is not | NTPC noted. |

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| | | | | | achieved; this shall be performed thro primary hydrocyclone and filtrate tank then again back to absorber. | |
| 1032. | PID No. 0011-109-POM-A-001 (a) Rev No A | | | | PH Meter and Density meter shall be located at the outlet of gypsum bleed line. This is the feasible solution to control PH value in the absorber oxidation tank and also control sorbent feed. | NTPC noted. |
| 1033. | **Project Information / Design clarified water analysis / Note** | | | As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder | We requests NTPC to provide the analysis for CW Blow down to enable us to design equipment's and scrubber. | Design Clarified Water Analysis provided in Technical specification based on which quality of CW blow down water shall arrived by the bidder considering Cycle of concentration (COC) specified. |
| 1034. | TECHNICAL SPECIFICATION SECTION-VI / PART-A SUB-SECTION-III-A1 | 3.01.04 | Page 3 of 9 | 2x100% limestone slurry pumps for each absorber connected to each of the limestone slurry tank (total 4 nos, of pumps for 2x800MW) each pump catering to slurry requirement of each units absorber. | Accordingly, we are considering slurry pumps as indicated below<br>1) For 3x800MW : 6 nos of slurry pumps<br>2) For 2x660MW : 4 nos of slurry pumps<br>3) For 3x660MW : 6 nos of slurry pumps<br>4) For 4x250MW : Please confirm each absorber no of | Bidders understanding is correct.<br>As asked, For 4x250MW : Total eight nos. of pumps for four units. |

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| | | | | | pumps and total number of pumps four units.<br>Kindly confirm. | |
| 1035. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A<br>SUB-SECTION-III-A1 | 7.01.00 | Page 5 of 9 | Process water & cooling water storage & pumping scheme **(For 2x800MW)** | We understand that 2nos process water tanks along with 2x100% Booster water pumps required for 2x800MW, 3x800MW, 2x660MW, 3x660MW & 4x250MW.<br>Kindly confirm. | Specification requirement is clear in this regards. Bidder shall comply with the specification requirements. |
| 1036. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A<br>SUB-SECTION-III-A1 | 7.01.01 &02 | Page 6 of 9 | 2x100% process water pumps ……**(total 4 nos, of pumps for 2x800MW)……** & 2x100% mist eliminator wash water pumps……**(total 4 nos, of pumps for 2x800MW)……..** | Accordingly, we are considering Process water pumps & Mist Eliminator Wash water pumps quantity as indicated below<br>1) For 3x800MW : 6 nos of pumps<br>2) For 2x660MW : 4 nos of pumps<br>3) For 3x660MW : 6 nos of pumps<br>4) For 4x250MW : Please confirm each absorber no of pumps and total number of pumps four units.<br>Kindly confirm. | Bidders understanding is correct.<br>As asked, For 4x250MW: Total eight nos. of pumps for four units. |
| 1037. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A | 25.00.00 | Page 9 of 9 | Wet stack condensate collection system | Each unit a separate wet stack is required or common wet stack shall be considered based on | Specification requirement is clear in this regards at referred cl. 25.00.00. Bidder shall comply |

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| | SUB-SECTION-III-A1 | | | | layout feasibility.<br>Kindly confirm. | with the specification requirements. |
| 1038. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A<br>SUB-SECTION-III-A4 | 1.00.00 | Page 3 of 3 | Equipment cooling water system | Equipment cooling water system requirement for Solapur-II, 2x660MW not indicated.<br>Kindly furnish the information. | Bidder may please refer scope of supply and services indicated on Page 3 of 3, Sub Section IIIA-04 for Solapur. |
| 1039. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A<br>SUB-SECTION-III-A5 | 2.01.15 | Page 4 of 6 | Minimum four (4) nos of sump pumps in limestone storage shed…… | 2 Nos of sump pumps in limestone storage shed is sufficient. | Technical Specification is clear. Bidder to provide minimum four numbers of sump pumps in limestone storage shed. |
| 1040. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A<br>SUB-SECTION-III-A6 | 1.01.00 | Page 1 of 3 | ……FGD waste water, GGH washing water etc….. | In this tender GGH is not specified in FGD process scope of supply. Hence, GGH washing water requirement not required. | Bidder's understanding is correct. GGH washing water is not required as GGH is not envisaged. |
| 1041. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A<br>SUB-SECTION-V | 6.00.00 | Page 10 of 26 | Limestone characteristics | 1. NTPC to confirm that given limestone characterises is for all units.<br>2. Please specify the limestone quality for design point and guarantee points. | Requirements of Technical Specification are clear at refered cl.no. 6.00.00. |
| 1042. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A<br>SUB-SECTION-V | 10.03.00 | Page 21 of 26 | 2x100% (1W+1S) conveying stream shall be provided in CHP. | CHP area conveying system is not in FGD bidder scope of supply.<br>However, only required modification in existing coal conveyor or new conveyor from track | Confirmed. |

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| | | | | | hopper/wagon tippler to lime crusher is in FGD bidder scope of supply.<br>Kindly confirm. | |
| 1043. | | | General | Layout observation for All 11 projects | It is presumed that NTPC has checked all the obstructions/interfaces with existing structures/foundations/equipment's and accordingly allocated the space in all plants free of encumbrances for all FGD facilities. | NTPC has taken all due diligence in allocating space for FGD. However, as per specification requirement, bidder is required to visit site and make his own assessment. |
| 1044. | TECHNICAL SPECIFICATION<br>SECTION-VI / PART-A<br>SUB-SECTION-III-A1 | 23.00.00 | 8 of 9 | Booster fan | Considering layout space issue we propose 1x100% booster fan for each unit instead of 2x50%.<br>Kindly confirm it is acceptable or not. | Bidder's understanding is not correct.<br>Specification requirement is clear at referred cl.no. 23.00.00. Bidder shall comply with the specification requirements. |
| 1045. | | | Layout Constraints & Space | Mouda-II-2x660MW<br>Allocated space:<br>1) 8m x 70 m-Left side of chimney<br>2) 8m x 70 m-Right side of chimney<br>3) 50 m x 39 m( 17m x 12 m corner cutting)<br>4) 45 m x 90 m( 15mx 30m corner | Mouda-II-2x660MW<br>1) In the layout allocated space is not sufficient for all FGD equipment's/buildings/facilities.<br>2) As per the layout, it is possible to locate Booster fan, absorber with pump house, | Available area is shown in amended GLP being issued separately. However, as per specification requirement, bidder is requested to visit site and make his own assessment. |

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| | | | | cutting)<br>5) 78 m 139 m | common (not individual) wet stack, lime grinding building, gypsum dewatering building only.<br>3) Other facilities like Lime handling shed, Gypsum handling shed, Electrical building, and tanks etc we are not having sufficient space to accommodate in the layout.<br>4) Hence, we request NTPC to identify and allocate the space to accommodate these facilities with all incumbrancers. | |
| 1046. | | | Layout Constraints & Space | SOLAPUR 2X660MW<br>Allocated space:<br>1) 50m x 70 m-Left side of chimney<br>2) 25m x 40 m-Right side of chimney | SOLAPUR 2X660MW<br>1) In the layout allocated space is not sufficient for all FGD equipment's/buildings/facilities.<br>2) As per the layout, the allocated FGD space (50x70m) is sufficient for 2 absorbers along with common (not individual) wet stack and pump house.<br>3) Other facilities like limestone | Available area is shown in GLP. However, as per specification requirement, bidder is requested to visit site and make his own assessment. |

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| | | | | | grinding building, gypsum dewatering building, Lime handling shed, Gypsum handling shed, Electrical building, and tanks etc we are not having sufficient space to accommodate in the layout.<br>4) Hence, we request NTPC to identify and allocate more space to accommodate these facilities with all incumbrancers/clearances. | |
| 1047. | | | Layout Constraints & Space | NABINAGAR 4X250MW<br>Allocated space:<br>1) Approx. 35mx275m<br>2) Approx. 40x410m | 1) As per the layout the allocated FGD space is sufficient for absorber, booster fan, wet stack and limestone grinding system, gypsum dewater buildings only.<br>2) Other areas like electrical buildings, lime handling system shed, gypsum handling system shed etc we are not having sufficient space to accommodate in the layout. We request NTPC to identify and indicate the suitable | Available area is shown in GLP. However, as per specification requirement, bidder is requested to visit site and make his own assessment. |

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| | | | | | space in the layout.<br>3) In layout allocated space is not sufficient for all FGD equipment's/buildings, facilities. NTPC may suggest additional space. | |
| 1048. | | | Layout Constraints & Space | MEJA 2X660MW<br>Allocated space:<br>1) Approx. 75mx65m | 1) No area marked in the plot plant for FGD space. NTPC to identify and provide the sufficient space for all FGD facilities.<br>2) The allocated space is shown in future unit area NTPC to confirm that for phase-I same shall be used or not. | 1. Bidder to refer Amended GLP being issued separately.<br>2. The space identified for Stage-II facilities cannot be used. |
| 1049. | | | Layout Constraints & Space | BARH 3X660MW<br>Allocated space:<br>1) 9x63 m right side of chimney<br>2) 25mx110m<br>3) 25mx284 m<br>4) 20mx48m<br>5) 20mx35m<br>6) 21mx15m<br>7) 131x650 | 1) In 9 m wide area not possible to use as width is very less.<br>2) NTPC to check and confirm that 25x284 m area in width wise is any possibility to get more width.<br>3) In layout allocated space is not sufficient for all FGD equipment's/buildings, facilities. NTPC may suggest additional space. | Available area is shown in amended GLP being issued separately. However, as per specification requirement, bidder is requested to visit site and make his own assessment. |

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| 1050. | | | Layout Con-straints & Space | GADARWARA 2X800MW<br>Allocated space:<br>1) Approx. 30mx110m-left side<br>2) Approx. 30mx110m-right side | 1) Space available for Absorber with pump house, booster fan, wet stack only.<br>2) NTPC to identify & provide space for gypsum handling system, electrical building and lime stone buildings, lime handing building spaces to accommodate all FGD facilities.<br>3) In layout allocated space is not sufficient for all FGD equipment's/buildings, facilities. NTPC may suggest additional space. | Available area is shown in amended GLP being issued separately. However, as per specification requirement, bidder is requested to visit site and make his own assessment. |
| 1051. | | | Layout Con-straints & Space | DARLIPALLI 2X800MW<br>Allocated space:<br>1) Approx. 30mx110m-left side<br>2) Approx. 30mx110m-right side | 1) Space available for Absorber with pump house, booster fan, wet stack only.<br>2) NTPC to identify & provide space for gypsum dewatering and handling system, electrical building and lime stone grinding buildings, lime handing building spaces to accommodate all FGD facilities.<br>3) We propose to use Left side | Available area is shown in amended GLP being issued separately. However, as per specification requirement, bidder is requested to visit site and make his own assessment.<br><br>S.No 3,4 and 5: Bidder is requested to visit the site as per the terms of the specifications. Bidder to carry out his own assessment and locate the |

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| | | | | | area which is now allocated for SG contractor space.<br>4) We presume that NTPC has checked the feasibility of FGD facilities i.e. absorber is located near the raw water reservoir which will pollute the raw water reservoir.<br>5) In layout allocated space is not sufficient for all FGD equipment's/buildings, facilities. NTPC may suggest additional space. | equipment/systems accordingly. |
| 1052. | | | Layout Constraints & Space | TANDA 2X660MW<br>Allocated space:<br>1) 30.35mx68.9m left side of chimney<br>2) 30.35mx68.9m right side of chimney<br>3) Green belt area (71.9+197.31+82.18+90.1+79+65+52) total area. | 1) Space available for Absorber with pump house, booster fan, wet stack only on both side chimney area.<br>2) Other FGD facilities possible to locate at the area shown near green belt area which is far way. Is it possible to take any space near by. | Available area is shown in amended GLP being issued separately. However, as per specification requirement, bidder is requested to visit site and make his own assessment. |
| 1053. | | | Layout Constraints & Space | NABINAGAR 3X660MW<br>Allocated space:<br>1) Approx. 152mx93m | 1) Space available for Absorber with pump house, booster fan, wet stack, Lime grinding system, gypsum de- | Available area is shown in amended GLP being issued separately. However, as per specification requirement, bid- |

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| | | | | | watering buildings are possible.<br>2) Other areas like Lime handling system shed, gypsum handling shed, electrical building etc we are not having sufficient space to accommodate in the layout. We request you to kindly identify the space and provide.<br>3) In layout allocated space is not sufficient for all FGD equipment's/buildings, facilities. NTPC may suggest additional space. | der is requested to visit site and make his own assessment. |
| 1054. | Sec.-VI, part-A | 1.04.01 | 1 of 3 | Normal make-up to ECW tank | Please provide us the location/co-ordinate of the tap off point **(for each project separately)** for our estimation & better under standing purpose. Tapping point shall be provided with a manual isolation valve, please confirm. | Corresponding header is available throughout the C-row and the bidder can take connection as per their convenient location. |
| 1055. | Sec.-VI, part-A | 1.04.02 | 1 of 3 | Emergency make-up to ECW tank | Please provide us the location/co-ordinate of the tap off point **(for each project separately)** for our estimation & bet- | Corresponding header is available throughout the C-row and the bidder can take connection as per their convenient location. |

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| | | | | | ter under standing purpose. Tapping point shall be provided with a manual isolation valve, please confirm. | |
| 1056. | Sec.-VI, part-A | 1.05.00 | 1 of 4 | Process water | Please provide us the location/co-ordinate of the tap off point **(for each project separately)** for our estimation & better under standing purpose. Tapping point shall be provided with a manual isolation valve, please confirm. | Corresponding header is available throughout the C-row and the bidder can take connection as per their convenient location. |
| 1057. | Sec.-VI, part-A | 1.06.00 | 1 of 4 | Gypsum wash water (Clarified water) | Please provide us the location/co-ordinate of the tap off point **(for each project separately)** for our estimation & better under standing purpose. Tapping point shall be provided with a manual isolation valve, please confirm. | Corresponding header is available throughout the C-row and the bidder can take connection as per their convenient location. |
| 1058. | Sec.-VI, part-A | 1.07.00 | 1 of 4 | Potable water | Please provide us the location/co-ordinate of the tap off point **(for each project separately)** for our estimation & better under standing purpose. | Corresponding header is available throughout the C-row and the bidder can take connection as per their convenient location. |

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| | | | | | Tapping point shall be provided with a manual isolation valve, please confirm. | |
| 1059. | Sec.-VI, part-A | 1.08.00 | 1 of 4 | Waste water | **Please clarify whether HCSD mixing tank & FGD waste water collection tank are same.** Please also provide us the location/co-ordinate of the waste water discharge point **(for each project separately where zero discharge is not in Bidder's scope)** for our estimation & better under standing purpose. | Specification requirement is clear. Bidder to comply with the specification requirements.<br><br>Bidder shall decide the location based on its offered design. |
| 1060. | | | | | Please provide us the Clarified Water Analysis and DM Water Analysis for NABINAGAR 3X660MW Power Plant as it is not legible from the TS. For others we will consider the same as mentioned in the TS for further designing of the system & no variation on the same during DE stage will be acceptable. | Bidder to refer the project specific details. The details asked seem to be quite legible for use. However, if required the Bidder may get the same from Address for communication as given in subject tender NIT. |
| 1061. | | | | | Please provide us the desired effluent analysis to be consid- | WWTP is part of Flue Gas Desulphurisation system package. |

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| | | | | | ered for the design of WWTP for each plant. In the absence of above it is not possible from our end to design the WWTP. | As such, effluent analysis for design of WWTP shall be decided by the Bidder based on its offered system. |
| 1062. | | | | | Please provide us the desired quality analysis of the recovered /treated water from WWTP for each plant separately & mention the parameters like suspended solids, Chlorides, Sulphate, Dissolve solids, PH range & approx. temperature etc. as applicable. | Refer above. |
| 1063. | Sec.-VI, part-B | 4.02.00 (vi) | 18 of 24 | Waste Water Functional Guarantees and Liquidated Damages | We understand that waste water treatment plant to be designed for average flow of 10 m3/hr to WWTP in 24 hrs period from each unit. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. Bidder to refer amendment in this regard. |
| 1064. | Sec.-VI, part-B | 3.01.00 (H - 3) | 15 of 32 | Final treated water to FGD service storage tank | We understand that final treated water from FGD Waste Water Treatment plant shall be directly supplied from treatment tank to FGD service water tank & this distribution system of the treated water from FGD WWTP plant to FGD plant shall | Confirmed. |

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| | | | | | be under Bidder scope only. Please confirm.<br><br>Also please inform us that which tank has been termed as **treatment tank & FGD service water tank.** | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |
| 1065. | Sec.-VI, part-B | 3.01.00 (C - 3) | 7 of 32 | MOC of aeration device | Pease provide us the material of construction (corrosion resistant material) for FGD aeration device. | The aeration devices shall be constructed of suitable corrosion<br>resistant material as per the proven practice of OEM which shall be decided during detailed engineering. |
| 1066. | Sec.-VI, part-B | 7.07.07 | 28 of 51 | PH correction of waste water | Please provide us the PH range to be considered for the effluent/waste water to be discharged after neutralization by lime dosing. | Specification requirement is clear under the referred cl.no. 7.07.07<br>. Bidder shall comply with the specification requirements. |
| 1067. | | | | Material size distribution for limestone | Please provide sieve analysis report for the Lime stone received from Mine. | Please refer Clause 10.06.00 (Page 22 of 26), sub-section V (Saliant Design Data & Sizing). The limestone delivered to power station shall be of size 250 mm and below. However, occasionally 1-2% coal of 400 |

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| | | | | | | mm lump size may also be encountered. |
| 1068. | Sec-IV-Part A | 10.07.00 | | No of crusher | As per tender bidder has option for selection of 2X50% or 1X100% crusher. However, as per clause 3.3.0 it is stated that each stream will have dedicated 2 nos. of grizzly feeders and 2 nos. of crusher means 2 x 50%. We understand that in case of 1 x 100%, 1 no. grizzly feeder and 1 no. crusher will be considered for each dedicated stream. Please confirm. | Noted. Suitable amendment shall be issued. |
| 1069. | Sec-IV-Part A | 2.01.10 | | Tripper/ flow diverter plough | As per feasibility of layout either Flow diverter or tripper will be considered on each feeding conveyor for storing the crushed lime stone to the covered storage area | Noted. |
| 1070. | Sec-IV-Part A | 2.01.19 | | Elevator | Please indicate elevator capacity for the Limestone crusher house | One (1) number conventional enclosure type passenger cum goods elevator having capacity of 16 persons (1088 kg) complying to IS:14665 (latest edition) with drives, all electrical, mechanical, civil, structural & associated foundation works, acces- |

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| | | | | | | sories and electrical to serve various floors of lime stone crusher house. Staircase access for machine room shall also be provided by the bidder. |
| 1071. | Sec-IV-Part A | 4.1.2 | | Idler Diameter | For Lower capacity of belt Conveyor we propose to go with 127mm dia idler for carrying & return side & impact idler with 114.3mm pipe diameter & with 25mm rubber thickness. Bearing diameter for carrying & return idler shall be 25mm & for impact idler bearing diameter shall be 30mm.Please confirm | Technical Specifications is clear. Bidder shall comply technical specifications. |
| 1072. | Sec-IV-Part B | 4.1.7 | | Tunnel Height | In tender specification, tunnel height is not specified. We propose to consider the tunnel height as 3200 mm. Please confirm | Tunnel height is to be considered as 3500MM. |
| 1073. | | | | Conveyor design | Please specify the % loading of the conveyor to be considered for selecting the Belt width | Bidder to refer Amendment regarding selection of belt width. |
| 1074. | | | | Vibration isolation system | Please clarify whether VIS is to be considered for lime stone crusher. | Vibration Isolation System is to be considered for lime stone crusher. |
| 1075. | | | | Modification in Existing Coal Conveyor | NTPC to note that during modifications, conveyor drive rating | Technical Specifications are clear. All necessary modifica- |

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| | | | | | for conveyor feeding to crushers may get change or drive margin considered may get reduced. Please confirm the scope of work in case of drive components gets changed. | tions involving Mechanical, Electrical, C&I, Civil and Structural works in the existing CHP for taking feed to new limestone path shall be in the scope of the bidder. Pls refer Cl.2.01.01 (page 2 of 6), Sub section III-A6, Section VI, Part – A of the technical specification. |
| 1076. | | | | Existing coal conveyor GA feeding to crusher house for all FGDs | Please provide existing coal conveyor profile/GA drawing and gallery cross section , which is feeding to coal crusher house for modification required in the existing system for tapping of limestone conveyor to the lime stone crusher house. | Noted. |
| 1077. | | | | Layout for Darlipalli -layout drg no. 9549-999-POC-F-001 | There is space constraint for limestone crusher house and storage. We propose to reduce the stockpile for coal adjacent to BC 3A/3B thereby we can provide limestone crusher house and storage.<br>Further crushed limestone will be fed to existing coal conveyor BC4A/4B for onward transportation through coal circuit con- | Existing Coal Stockpile area has been planned considering requirement of existing plant and, therefore, the area marked for the same shall not be proposed by the bidder for FGD facilities like limestone crusher house and storage.<br><br>The detailed scheme for limestone conveying shall be dis- |

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| | | | | | veyor up to TP-11. | cussed with successful bidder during detailed engineering. |
| 1078. | | | | Layout for Gadarwara-layout drg no. 9572-999-POC-F-001 | There is space constraint for limestone crusher house and storage. We propose to reduce the stockpile for coal adjacent to BC 2A/2B thereby we can provide limestone crusher house and storage.<br>Further crushed limestone will be fed to existing coal conveyor BC4A/4B for onward transportation through coal circuit conveyor up to TP-10. | Existing Coal Stockpile area has been planned considering requirement of existing plant and, therefore, the area marked for the same shall not be proposed by the bidder for FGD facilities like limestone crusher house and storage.<br><br>The detailed scheme for limestone conveying shall be discussed with successful bidder during detailed engineering. |
| 1079. | | | | Alternate proposal for lime stone transportation | Wherever, limestone cannot be transported through Belt Conveyor to day bin silo at FGD area due to layout constraint, Bidder propose for limestone grinding system near lime stone crusher house & slurry shall be transported up to absorber in FGD area through slurry piping. | The detailed scheme for limestone transportation shall be discussed with successful bidder during detailed engineering. |
| 1080. | SUB SECTION –I-M4 | 2.00.00 | 91 | Hydrant system shall consists of piping, hydrant valve… | It is presume that, fire water with suitable pressure (8 Kg/cm2) shall be made available | Bidder understanding is correct. |

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| | | | | | by Employer at T.O.P. No fire water pump is envisaged by bidder. Please confirm. | |
| 1081. | SUB SECTION –I-M4 | - | 91 | - | It is presume that, fire protection system shall consists of hydrant system, HVW & MVW Spray system and Fire extinguisher. No gas based fire protection system, foam system is considered by bidder. Please confirm. | Bidder understanding is correct. |
| 1082. | SUB SECTION –I-M4 | 3.01.00 | 91 | Spray system | It is presume that, spray water shall be tapped of from hydrant network. Hence, no spray pump is required to be considered. Please confirm. | Bidder to refer relevant amendment in this regard. |
| 1083. | SUB SECTION –I-M5 | 2.02.00 | 1 of 16 | The secondary circulating water system shall receive water through tapping from CW blow down from the CW pumps Discharge header… | We understand that for all the eleven (11) packages, the water for secondary side (ACW side) of PHE shall be tapped from the CW blowdown. And which shall be tapped from the CW pump Discharge header. Please confirm | Bidder's understanding is correct. |
| 1084. | SUB SECTION –I-M5 | 2.02.00 | 2 of 16 | …. The Discharge secondary water from PHEs shall be used as process water for FGD system. | No cooling tower is considered for cooling of PHE secondary outlet (hot) water. Hot water from secondary side of PHE | Bidder's understanding is correct |

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| | | | | | shall be directly used for FGD process. Please confirm. | |
| 1085. | SUB SECTION –I-M5 | 2.05.00 | 2 of 16 | To prevent fouling on the secondary cooling side of the PHE, Self-cleaning type filters (2x100%) shall be provided by the bidder on secondary cooling water inlet header to the PHE. | We are considering 2x100 % Simplex type self-cleaning filters at common PHE supply header. Please confirm. | Bidder shall comply the specification requirement. |
| 1086. | Part B/Section-VI/Sub sectionI-M2 | 2.01.00 | 1 of 26 | The areas to be air conditioned shall be as follows: | Requested to provide design indoor condition for air conditioning rooms. | For design indoor condition of Air-conditioning system, Bidder to refer Sl no.3 of Clause no.7.01.00,Page no. 11 of 26 Sub-section-V, Part-A of Technical specification, Section- VI. |
| 1087. | Part B/Section-VI/Sub sectionI-M2 | 2.01.00 | 1 of 26 | The areas to be air conditioned shall be as follows: | Requested to provide design outdoor condition for selection of air conditioning systems. | Bidder to refer Sl no.1 , Clause no.7.01.00 Salient Design Data ,Page no. 11 of 26 Sub-section-V Part-A of Technical specification Section VI. |
| 1088. | Part B/Section-VI/Sub sectionI-M2 | 2.01.00 / (b) | 1 of 26 | Cassette and Hiwall air conditioners for other auxiliary control room/control room buildings... | Requested to clarify whether 100% redundancy is required for Cassette type Unit. Hiwall AC units. | Bidder to refer 7.02.01 (b) Page no. 13 of 26 Salient Design Data, Sub-section-V, Part-A of Technical specification, Section VI. |
| 1089. | Part B/Section-VI/Sub sectionI-M2 | 2.01.00 / (b) | 1 of 26 | Cassette and Hiwall air conditioners for other auxiliary control room/control room buildings... | Requested to clarify whether Hiwall AC units will be 3 star or 5 star rating. | Bidder to refer Clause 1.00.00 (d), page 1 of 4 ,Sub Section III-A2, Part-A of Technical specification, Section VI. |

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| 1090. | Part B/Section-VI/Sub sectionI-M2 | 2.01.00 / (b) | 1 of 26 | Cassette and Hiwall air conditioners for other auxiliary control room/control room buildings... | Requested to clarify whether fresh air is required to be provided for cassette type units by providing separate fan and ducting. | Bidder shall comply with spec requirements. |
| 1091. | Part B/Section-VI/Sub sectionI-M2 | 2.01.00 / (b) | 1 of 26 | Cassette and Hiwall air conditioners for other auxiliary control room/control room buildings... | Requested to note that humidity control will not be possible for areas with cassette type or Hiwall AC units. | Noted |
| 1092. | Part B/Section-VI/Sub sectionI-M2 | 3.01.00 / i | 1 of 26 | Unitary Air Filtration (UAF) units of min capacity 75000 cmh/hr ..... | Requested to confirm that equipment heat dissipation loads need not be considered for ventilation areas with UAF unit. Selection shall be as per specification only. | Bidder to refer relevant amendment in this regard. |
| 1093. | Part B/Section-VI/Sub sectionI-M2 | 3.01.00 / i | 1 of 26 | Unitary Air Filtration (UAF) units of min capacity 75000 cmh/hr ..... | Requested to confirm whether any redundancy to be provided for UAF units. | Bidder to refer relevant amendment in this regard. |
| 1094. | Part B/Section-VI/Sub sectionI-M2 | 3.01.00 / i | 1 of 26 | Unitary Air Filtration (UAF) units of min capacity 75000 cmh/hr ..... | Requested to clarify whether UAF unit to be selected for 3 deg C or 5 deg C above ambient design DBT inside ventilated room. | For evaporative cooling, Bidder to refer Cl No 7.03.00, (2a), Sub-section-V, Part A of technical specification, Section VI. |
| 1095. | Part B/Section-VI/Sub sectionI-M2 | 3.01.00 / i | 1 of 26 | Unitary Air Filtration (UAF) units of min capacity 75000 cmh/hr ..... | Requested to clarify whether makeup water for UAF unit to be arranged by contractor or NTPC shall provide the same. | Provisions of Technical specification are clear. Bidder shall comply with the same. |
| 1096. | Part B/Section- | 3.01.00 | 1 of 26 | Mechanical ventilation (using roof | Requested to provide air change | Bidder to refer Cl No 7.03.00 , |

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| | VI/Sub sectionI-M2 | / ii | | extractors/ supply ….. | per hour to be considered for Grinding system building, Gypsum dewatering building, recirculation pump and oxidation blower/ compressor building as well as other areas such as toilets. | Sub-Section-V, Page no. 13 of 26 , Sub-section-V, Part-A, of Technical specification, Section VI. |
| 1097. | Section VI, Part B, Sub section-IV-D | 17.08 | 35 of 69 | For design of liquid retaining structures, IS : 3370 ( Part - I to IV ) ( latest ) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. | As per latest code of IS : 3370(Part 2): 2009, Clause 4.4.1.2.b, surfaces of liquid retaining structures shall be designed for 0.2mm crack width as per limit state design. Please confirm. | All RCC liquid retaining structures shall be designed by working stress method as per clause no. 4.5 of IS:3370 (Part-2):2009, as per technical specification. |
| 1098. | Section VI, Part B, Sub section-IV-D | | | Please provide existing soil report with borehole log data nearby the proposed site of the project for reference. | | Bidder may refer Project information chapter furnished in Technical specification. Further, Bidder may also refer Amendment for the Borelog data of Darlipalli, Meja and Solapur. |
| 1099. | Section VI, Part B, Sub section-IV-D | | | Please provide topographical survey drawing nearby the proposed site of the project for reference. | | Topographical survey drawing are furnished with tender document. |
| 1100. | *Section VI, Part B, Sub section-IV-D* | *3.01* | *3 of 69* | No painting, galvanization shall be provided in gratings | The two clauses appear contradicting each other please confirm whether gratings shall be hot dip galvanized or not. | All gratings shall be hot dip galavanized as per technical specifications except for Truck hopper gratings which shall be provided two coats of Red oxide |
| 1101. | Section VI, Part B, | | 8 of 69 | All gratings shall be hot galvanized | The two clauses appear contra- | |

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| | Sub section-IV-D | | | at the rate of 610 g. sq.m after surface preparation by means of blast cleaning/ acid pickling. | dicting each other please confirm whether gratings shall be hot dip galvanized or not. | primer immediately after fabrication.<br>Technical specification requirement is clear in this regard. |
| 1102. | Section VI, Part B, Sub section-IV-D | **3.01** | 3 of 69 | 50 mm thick PCC shall be provided under the raft, followed by polymer modified coating in two layers as per manufacture specs. 50mm thick PCC shall then be laid over polymer modified cementitious coating before laying raft. | Please confirm whether total of two layers or only single layer of 50mm thick PCC is required to be provided below raft, in addition to lean concrete and 2 layers of polymer modified coatings. | Two Layers of 50mm thick pcc shall be provided over lean concrete , one before laying of polymer modified coating(in two layers) and other after laying polymer modified coating. |
| 1103. | Part A – Sub Section III C / C&I System | 02.03.02 | 81/209 | CEMS<br>Analyzer Connectivity provision for bidirectional communication with Employer's cloud server . Necessary hardware & software shall be provided by contractor. | Please specify the Hardware & Software details required for this communication establishment. | Specification requirement is clear. Bidder shall comply with the specification requirement. |
| 1104. | Part A – Sub Section III C **/** C&I System | 04.00.00.D | 83/209 | I&C Cable<br>Cable required for interfacing PLC control system with employers DDCMIS | We assume 50 nos hardwire signals to be interfaced from FGD PLC to employer DDCMIS. Please confirm. | Bidder's understanding is not correct.<br>Bidder to refer clause 9.01.00, PART-A Sub Section-IIIC, wherein the minimum number of hardwired signal exchange per unit is mentioned as DI – 80, DO – 80, AI – 20 and AO – 20. Bidder shall comply with the specification requirement. |
| 1105. | Part A – Sub Section | 04.00.0 | 83/209 | I&C Cable | All these CEMS signals are ter- | Bidder's proposal is not ac- |

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| | III C / C&I System | 0.E | | Cable required for interfacing CEMS signal with employers DDCMIS | minating at FGD PLC. It shall be communicated to employer DDCMIS from FGD PLC as soft signals. Please accept. | ceptable. CEMS signals shall be connected to employer's DDCMIS through hardwired signal exchange. |
| 1106. | Part A – Sub Section III C / C&I System | 08.00.00 | 85/209 | Tools & tackles<br>Contractor shall provide new set of all special tools & tackles. | Please provide us the list. We shall comply to that. | The list of Tools and Tackles shall be discussed and decided during detailed engineering. |
| 1107. | Part A – Sub Section III C / C&I System | 09.01.00 | 85/209 | PLC Remote Input output (RIO) for PLC per unit, placed in employer CCR. | We shall make use of common Employer's signal earthing/grounding , ventilation & its Air conditioning system for the placing of RIO device. Please confirm. | Bidder's understanding is correct. However, cabling from RIO panel placed in CER to employer's earth riser shall be in contractor's scope of supply. |
| 1108. | Part A – Sub Section III C / C&I System | | | Vibration Measurement<br>Vibration measuring & monitoring for drives | As per FGD spec, we are considering vibration monitoring for Crusher only.<br>We propose the use of velocity transducers with inbuilt signal conditioner for direct measurement of vibration. Please accept | It is clarified that Vibration Monitoring System (VMS) is not the scope of the bidder.<br><br>However, vibration measurement is envisaged for each vibration measurement point as indicated in<br>a)Tender drawing "0011-109-POM-A-001"<br>b) PART A, Clause 23.01.00 of sub section III-A1<br>c) PART-A, Clause 2.01.06 of sub section III-A5. |

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| | | | | | | It is further clarified that as per clause 1.07.00 of sub section III-C2 PART B of technical specification, vibration measuring instrumentation shall be as per the standard and proven practice of the bidder. Vibration measuring instrumentation output (4-20mA) shall be connected to FGD control system instead of vibration monitoring system. |
| 1109. | Part A - SUB-SECTION-III-C (C&I) MEASURING IN-STRUMENTS | 2.01.00 | 79/209 | Analyzers<br>Density analyzer - Specification | The specification for density analyzers specifies the working principle as nucleonic density meter. We propose the use of any other principle of density measurement device. Please accept | Bidder's understanding is not correct.<br>Bidder to refer clause 2.01.00, PART-A Sub Section-IIIC, wherein it is mentioned that density meter (Coriolis type) shall be in the scope of the bidder. In case the bidder proposes other type of density meter as per the bidder standard and proven practice, the same shall also be acceptable except Nucleonic type density meter. Bidder shall comply with the specification requirement. |
| 1110. | Part B - Sub Section- | 5.00.00 | 45/103 | LIE/LIR | We shall make all possible effort | Bidder's proposal is noted. |

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| | III-C3 / Process Connection & Piping | | | All transmitters & switches shall be suitably grouped together & mounted inside. | to group transmitters & switches. However for odd location & single equipment, transmitter with canopy shall be installed for ease of access & suitable for measurement.<br>Please accept. | |
| 1111. | Part B - Sub Section-III-C3 / Process Connection & Piping | 5.01.00 | 46/103 | Temp Tx<br>Enclosure / rack for temperature transmitter | We shall make all possible effort to group transmitters. However, for odd locations / single instrument, transmitter with canopy shall be installed for ease of access & suitable for measurement.<br>Please accept. | Bidder's proposal is noted. |
| 1112. | Part B - Sub Section-III-C5 / PLC Based Control System | 1.05.00 | 63/103 | PLC System<br>ON/OFF control, indication, annunciation of incomers and buscoupler (even if they<br>are not in the scope of the contractor) are also to be performed from Contractor's<br>Control System for each of the plant auxiliary system as applicable. | We shall extend to the respective feeder. Further interfacing will be carried out by employer.<br>Please accept. | Bidder's proposal is not acceptable. Bidder shall comply with the specification requirement. |
| 1113. | Part B - Sub Section-III-C5 / PLC Based Control System | 05.03.09 | 75/103 | PLC System<br>For inching type of drive, position transmitter power supply shall be | We propose the use of loop powered position transmitter, which doesn't require additional | Bidder's proposal is also acceptable subject to the compliance of other specification re- |

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| | | | | provided. | power supply. Please accept. | quirements. |
| 1114. | Part B – Section VI, Sub Section-I-M1 | 4.05.00 (d,e) | 12/51 | Adequte numbers of duplex Pt-RTD (100 ohm at 0 degree Celsius) and temperature indicator shall be provided for each bearing. Local as well as remote monitoring features shall be provided.<br><br>For mounting of vibration pads/pickups, flat surfaces shall be provided both<br>in X and Y directions, by the Contractor on the bearing housing. | We understand that the mentioned clauses are applicable for HT motors only. Kindly confirm. | Bidder understanding is not correct. The referred clause is applicable for booster fans. Bidder shall comply with the specification requirement. |
| 1115. | Part B – Section VI, Sub Section-I-M1 | 6.02.03 | 21/51 | Each Silo shall be provided with sufficient no. of level transmitters. | We propose 1 number ultrasonic level transmitter per silo. Kindly accept. | Bidder's proposal is not acceptable. Bidder to provide minimum 02 no. of Level transmitters per silo.<br>Amendment shall be issued in this regard. |
| 1116. | Part B – Section VI, Sub Section-I-M1 | 7.07.09 | 29/51 | Contractor shall provide.....level switches, air relief devices, etc. | We propose 1 number ultrasonic level transmitter per silo. Kindly accept. | Bidder's proposal is not acceptable. Bidder to provide minimum 02 no. of Level transmitters per silo.<br>Amendment shall be issued in this regard. |

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| 1117. | Part B – Section VI, Sub Section-I-M4 | 5.03.07<br>5.03.16 | 3/18 | The coverage or the zone of protection afforded by the detector and recommended height of mounting shall be furnished by the Bidder. The bidder shall furnish the test certificate in support of this. | The spacing and height of the detectors shall be as per IS 2189. Kindly accept. | Noted. |
| 1118. | Part B – Section VI, Sub Section-I-M4 | 5.08.03 | 6/18 | FGD and ZLD (as provided) Fire alarm system shall be provided with necessary interface<br>hardware and software for communicating fire alarms from this fire alarm panel to the main plant fire alarm control panel through potential free contacts. | We propose one fire alarm panel at FGD control room only. Kindly accept the same. | The main plant fire alarm control panel is in Employer's scope.<br>Necessary hardware and software for communicating fire alarms from the bidder's fire alarm panel (for FGD and ZLD area) to the employer's fire alarm panel is in the scope of the bidder. |
| 1119. | Part B – Section VI, Sub Section-I-M4 | 5.06.00 (d) | 6/18 | Each detector in a loop shall have short circuit isolator suitable for style-7 wiring as<br>per NFPA-72. | As specified in Clause 5.09.08, We shall consider class A wiring for fire detection system.<br>Kindly accept the same. | Bidder's understanding is correct. |
| 1120. | Part B – Section VI, Sub Section-I-M6 | 4.7.4 | 11/73 | The tripper shall run on rails (90 lbs/yard) with double flanged wheels. Rails for tripper travel<br>shall be mounted on supporting structure of respective conveyors. Suitable system having<br>encoders for monitoring position of | We understand that DDCMIS shall be read as FGD PLC. Please confirm.<br><br>It is noticed that the DDCMIS has been mentioned time and again in the specification for | Bidder's understanding is correct. |

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|---|---|---|---|---|---|---|
| | | | | tripper in DDCMIS shall be provided. | FGD system, we understand that the same refers to FGD PLC. Please confirm. | |
| 1121. | Part B – Section VI, Sub Section-I-M6 | 4.01.00<br>4.03.01<br>4.08.00 | 60/73<br>61/73<br>67/73 | Overall, operation of the following equipment of Lime Handling Plant shall be controlled from<br>the main FGD control room through FGD DDCMIS being provided by the Contractor.<br><br>The lime handling plant being provided by bidder envisages control of complete lime<br>handling system including facilities under subject package by DDCMIS.<br><br>DDCMIS/Control desk shall be provided with…. | understand that DDCMIS shall be read as FGD PLC. Please confirm.<br><br>It is noticed that the DDCMIS has been mentioned time and again in the specification for FGD system, we understand that the same refers to FGD PLC. Please confirm. | Bidder's understanding is correct. |
| 1122. | Part B – Section VI, Sub Section-I-M7 | 3.02.03 (8) | 20/32 | Tanks and access hatches shall be designed in accordance with API Code 650. Remote level indicators or alarm shall be provided for all tanks. | We understand that remote level indicator shall be mounted close to the tank for local indication. Please confirm. | Bidder's query is not clear. Bidder to follow specification requirements. |
| 1123. | Part-A/Section – VI/ Sub-section – IIIB | Cl.1.08.00/ point No. 2 | 2 of 6 | In case of non-availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection, cable lay- | We understand that new cable tray shall be erected on employer's cable trestle. We do not envisage new cable trestle | Bidder shall comply with technical specification requirement clause no: - 1.08.00.2. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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| | | | | ing. | for the cables to be laid from employer's board.<br><br>Kindly confirm. | |
| 1124. | Part-A/Section – VI/ Sub-section – IIIB | Cl.1.08.00/ point No. 2 | 2 of 6 | In case of non-availability of space in employer's trestle, contractor shall make necessary arrangements for cable tray erection, cable laying. | We request client to provide the existing cable trestle and section drawing for all the projects. | Bidder shall comply with technical specification requirement clause no: - 1.08.00.2.However bidder may visit the project in order to get itself acquainted with existing electrical of plant. GLP of respective plants has already been attached. |
| 1125. | Part-A/Section – VI/ Sub-section – IIIB | Cl.1.09.00 | 3 of 6 | Complete lighting system for internal and external areas of plants, buildings, chimney and equipment's in the bidder's scope. | We do not envisage street lighting for the existing roads. Illumination for approach roads of FGD facilities are only considered in bidder's scope of work.<br><br>Kindly confirm. | Bidder to provide complete lighting for roads under his scope |
| 1126. | Part-A/Section – VI/ Sub-section – IIIB | Cl.1.09.00 | 3 of 6 | Lighting fixtures complete with lamps, .....chimney aviation light | We understand that aviation lights for existing chimney is not in bidder's scope of work.<br><br>Kindly confirm. | Bidder understanding is correct. |
| 1127. | Part-A/Section – VI/ Sub-section – IIIB | Cl.1.10.00 | 4 of 6 | Complete below ground earth mat and above ground equipment earthing system | We do envisage peripheral below ground earth mat for FGD area in our scope of work.<br>However, we do not verify the | Bidder shall comply with requirement of technical specifications clause no:- 5.01.00 |

| S.No | Volume / Section | Clause No. | Page No. | Description / Tender specification | Bidder comments / Deviations | NTPC Clarifications |
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| | | | | | step and touch potential voltage in our scope of work.<br><br>Kindly confirm. | |
| 1128. | Part-A/Section – VI/ Sub-section – IIIB | Cl.1.12.00 | 4 of 6 | To meet the construction power requirement of FGD and associated systems, the employer shall provide two number 415V feeders in LT switchgears. | We understand that the construction power is provided free of cost.<br><br>Also request client to provide the location of two numbers of 415V feeders for all the projects.<br><br>Kindly confirm and clarify the details | Bidder's understanding is not correct.<br>The referred clause no. 1.12.0 of Tech. Specifications is amply clear.<br><br>Locations shall be identified during FGD Contract execution stage. |
| 1129. | Section- VI/ Electrical Single Line diagram for FGD system | | 53 of 53 | Feeder for AHP/CHP HT transformer | We request client to provide the following details for all the projects:<br>Existing 11kV feeder details feeding to AHP/CHP transformer<br>Rating and location of AHP/CHP transformer<br>Cable routing layout from 11kV station switchgear to AHP/CHP transformer. | Details for feeders proposed to be used for FGD system have included in AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |

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|---|---|---|---|---|---|---|
| 1130. | Section – VI/ Sub-section – II-E | CL.2.04.00 | 4 of 7 | These relays shall be integrated with employer's switchgear SCADA through Ethernet switches (to be supplied by employer) mounted on each switchgear. | In line with referred clause, we understand that client shall supply Ethernet switches to be mounted on bidder supplied switchgear.<br><br>Kindly confirm. | This clause is deleted.<br><br>Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI) |
| 1131. | Section – VI/ Sub-section – II-E1 | CL.2.07.00 | 5 of 7 | The earthing system for plant shall be designed for life ……for fault current of 50 kA for 1 sec. | We do envisage to extend the existing below ground earthing mat in our scope of work.<br><br>We do not submit any design calculations.<br><br>Kindly confirm. | Bidder shall comply with requirement of technical specifications clause no:- 5.01.00 |
| 1132. | Section – VI/ Sub-section – II-E4 | CL.2.00.00 | 1 of 6 | | We understand that LT power cables of sizes 95 sq.mm and below shall be laid in two layers and above 95 sq.mm shall be laid in single layer is acceptable to client.<br><br>Kindly confirm. | The same shall be decided during detailed engg. |
| 1133. | Section – VI/ Sub-section – II-E6 | CL.2.01.04 | 2 of 69 | No sub zero level cable vault/trenches shall be provided below control buildings/switchgear rooms in main plant. | In line with CL. 2.01.04, we understand that cable trenches are acceptable for client in FGD area. | Bidder understanding is correct. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| S.No | Volume / Section | Clause No. | Page No. | Description / Tender specification | Bidder comments / Deviations | NTPC Clarifications |
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| | | | | | Kindly confirm. | |
| 1134. | Section – VI/ Sub-section – II-E6 | CL.2.01.05 | 2 of 69 | Cable vault | | No query asked. |
| 1135. | Section – VI/ Sub-section – II-E7 | CL.2.16.01, c) | 4 of 6 | Short circuit withstand capability | We do envisage duration of short circuit as 0.2 sec for 11kV tie cable from Employer 11kV station switchgear to 11kV FGD switchgear.<br><br>Kindly confirm. | Requirement of Tech Specification Part B/ Section-VI sub section II – E1 clause 7.00.00 to be complied. |
| 1136. | Section – VI/ Sub-section – II-E12 | CL.1.01.00 | 1 of 31 | Outdoor transformer | We request client to specify the energy efficiency level of 11/0.433kV service transformer. | Bidder shall comply with specification clause no. 2.00.00.f of Part B/ Section-VI sub section II – E12 |
| 1137. | Section – VI/ Sub-section – II-E15 | CL.3.02.02 | 4 of 16 | Emergency AC lighting | We do envisage 20% of total fixtures of particular area to be fed from emergency Ac lighting.<br><br>Kindly confirm. | Bidder to refer necessary amendment in this regard. |
| 1138. | Section – VI/ Sub-section – II-E15 | Annexure-A, point d) | 15 of 16 | Battery room : Totally enclosed corrosion proof LED luminaire | We do envisage conventional fixtures for Dc lighting, hazardous area, high mast (if applicable) and aviation lighting.<br><br>Kindly confirm. | Technical specifications are clear. Bidder shall comply with technical specification requirement. |
| 1139. | Soil resistivity | | | | We request client to provide | Bidder to refer necessary |

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| S.No | Volume / Section | Clause No. | Page No. | Description / Tender specification | Bidder comments / Deviations | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | | | | | the soil resistivity value for all the projects. | amendment in this regard. |
| 1140. | Earthing Layout | | | | We request client to provide the existing earthing layout for all the projects. | Shall be provided during detail engineering. |
| 1141. | General | | | | We request client to specify the route length from FGD system to 11/3.3kV existing CHP/AHP transformer. | Refer amended tender SLD & GLP. |
| 1142. | General | | | | Request NTPC to provide auto-cad drawing of 11 projects plot plans. | Only PDF provided. |
| 1143. | General | | | | Request NTPC to provide duct elevation drawing from ID fan to chimney for all 11 projects. | Same will be discussed with the successful bidder during the detail engg. stage. |

| Sr. No. | Document No | Sub Section | Page No | Clause No. | Subject | Clarifications requested | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| 1144. | Technical Specification Section-VI, | Sub Section -I | 3 of 19 | 1.03.06 | Wet stack | Please advise whether we can consider chimney mounted on absorber as a integral chimney. | Bidder shall comply with the requirements of Tech-nical Specifications. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Document No | Sub Section | Page No | Clause No. | Subject | Clarifications requested | NTPC Clarifications |
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| 1145. | Part-A, BID doc no : CS-0011-109-(1A)2 | Sub Section -III-A5 | 2 of 6 | 2.01.01 | LHP | Client to confirm plant specific limestone unloading by truck or by wagon to design system accordingly. | Technical Specifications is clear. Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes.<br><br>Road unloading facility shall be provided for all the plants under this package. Wherever feasible, railway unloading shall also be provided using existing Wagon Tippler / Track Hopper as detailed out in the Technical Specifications. |
| 1146. | | Sub Section -III-A5 | - | 2.00.00 & 3.00.00 | LHP & GHP | Client to earmark space in layout for both these facilities | Space available for FGD and associated system is marked in the General Layout Plan drawings attached with the Technical Specifications. Bidder has to propose the layout for LHP & GHP to cater the requirement of FGD plant based on the layout of FGD system and existing facilities. |

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| Sr. No. | Document No | Sub Section | Page No | Clause No. | Subject | Clarifications requested | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| 1147. | | Sub Section -III-A5 | 6 of 6 | 3.03.00 | Sump pump | Please clarify quantity (Word and number not matching) | The number of sump pump shall be read as four (4). Necessary Amendment shall be issued. |
| 1148. | | Sub Section -V | 3 of 26 | 2.00.00 & 3.00.00 | Salient design data | Meja-I appears in both design criterias of mentioned clauses, please clarify which design data to be referred for Meja-I | Refer necessary amendment in this regard. |
| 1149. | | Sub Section -V | 08 of 26 | 5.01.00 | Wet Chimney | Whether alternate material like "FRP" can be proposed | Bidder shall comply with the requirements of Technical Specifications under the referred cl.no. 5.01.00. |
| 1150. | | Sub Section -V | 10 of 26 | 6.00.00 | Limestone data | Size of raw limestone received at site to be provided | Please refer Clause 10.06.00 (Page 22 of 26), sub-section V (Saliant Design Data & Sizing). The limestone delivered to power station shall be of size 250 mm and below. However, occasionally 1-2% coal of 400 mm lump size may also be encountered. |
| 1151. | | Sub Section -VI | 18 of 24 | 4.02.00 (vi) | Waste water | The quantity of waste water may vary plant to plant based on various conditions, hence cap on waste water discharge shall be eased. | Bidder shall comply with the requirements of Technical Specifications. |

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| Sr. No. | Document No | Sub Section | Page No | Clause No. | Subject | Clarifications requested | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| 1152. | | Part-B, Sub Section -I-M1 | 7 of 51 | 3.03.09 | Guillotine Damper | Is this pneumatic or motorised | Motorized. |
| 1153. | | Part-B, Sub Section -I-M1 | 8 of 51 | 4.01.01 | Booster fan | Referring to point no 5 above, please reconfirm the design flow of fan for Solapur & Meja | Specification requirement is clear. Bidder shall comply with the specification requirements |
| 1154. | | Part-B, Sub Section -I-M1 | 10 of 51 | 4.02.00 | Booster fan | Please clarify does the margins means equipment selection at Flow x 1.2 @ Head x 1.44 | Specification requirement is clear. Bidder shall comply with the specification requirements at referred cl.no. 4.02.00. |
| 1155. | | Part-B, Sub Section -I-M1 | 24 of 51 | 6.07.03 | Slurry pipes | Should FRP pipes be considered | Specification requirement is clear. Bidder shall comply with the specification requirements at referred cl.no. 6.07.03. |
| 1156. | | Part-B, Sub Section -I-M1 | 26 of 51 | 7.04.02 | Filter cloth | Since VBF suppliers are guaranting only 4000 hrs, may be reviewed. | Specification requirement is clear. Bidder shall comply with the specification requirements at referred cl.no. 7.04.02. |
| 1157. | | Part-B, Sub Section -I-M1 | 27 of 51 | 7.05.06 | Plate valve | Please elaborate the need | Specification requirement is clear. Bidder shall comply with the specification requirements at referred cl.no. 7.05.06. |

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| Sr. No. | Document No | Sub Section | Page No | Clause No. | Subject | Clarifications requested | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| 1158. | | Part-B, Sub Section -I-M1 | 33 of 51 | 12.01.00 | Slurry pipes | Should all pipes be considered as FRP | Specification requirement is clear. Bidder shall comply with the specification requirements at referred cl.no. 12.01.00. |
| 1159. | | Part-B, Sub Section -I-M6 | 2 of 73 | 3.2.0 | LHP | Coal may contaminate limestone, recommend to use truck systems. | Noted. |
| 1160. | | Part-B, Sub Section -I-M6 | 3 of 73 | 3.3.0 | LHP | Please confirm feed size of limestone | Please refer Clause 10.06.00 (Page 22 of 26), sub-section V (Salient Design Data & Sizing). The limestone delivered to power station shall be of size 250 mm and below. However, occasionally 1-2% coal of 400 mm lump size may also be encountered. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section No. | Clause No. | Bid Specification Stipulation | Bidder's Query / Stipulation | NTPC Clarifications |
|---|---|---|---|---|---|
| 1161. | Part-A-Sub Section-II-A6 | Clause no.7.08- Page no.19 | Foundation System and Geotechincal Data- Type of Foundation system to be adopted- Open Foundation system. | The foundation design shall be based on final recommendations of geotechnical investigation report approved by Client during execution. Provision shall be made for appropriate compensation If any major variation in the soil data/ sub-soil conditions if identified. | Bidder may refer Cl. No. 7.00.03. If bidder feels, data provided is not adequate, he may carry out geotechnical investigation for bidding purpose. Further, Bidder shall comply the provisions of Technical Specification. |
| 1162. | Sub-Section-IVD -CIVIL WORKS | Clause no.12.00 | RCC Roads & RCC Drains | Bidder understands that only approach roads along with drains on both sides shall be provided from the new structures of the proposed FGD. The main plant roads and drains shall be in the scope of the client. Please confirm. | Refer Scope of work. Refer clause 2.00.00 Section-VI, Part-A of technical specification. |
| 1163. | Sub-Section-IVD -CIVIL WORKS | Clause no.13.00 | Gate Along Boundary Wall | Bidder understands that any works for construction of gate along boundary wall is excluded from the bidders scope of work. | Refer Scope of work. Refer clause 2.00.00 Section-VI, Part-A of technical specification. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section No. | Clause No. | Bid Specification Stipulation | Bidder's Query / Stipulation | NTPC Clarifications |
|---|---|---|---|---|---|
| 1164. | Sub-Section-IVD -CIVIL WORKS | Clause no.4.01 | Contractors scope shall include construction of necessary culverts below railway lines/ roads as per the railway/IRC standards and shall take approvals of railway culverts from the concerned railway authorities. | Bidder has considered RCC hume pipe culverts only below the approach roads in the scope of works for this package. Bidder has excluded the construction of culverts below railway lines and taking their approvals from necessary railway authorities. Bidder request client to kindly confirm. | Bidder shall comply with technical specification requirement. |
| 1165. | Sub-Section-IVD -CIVIL WORKS | Clause no.14.00 | The Storm Water drainage for any area under consideration shall be taken in to account the finished grade levels of the area. | Bidder has considered only the drains along the approach roads and garland drains around the proposed structures. These drains shall be connected to the nearest main plant drains with proper slopes. Please confirm. | Bidder's understanding is correct. |
| 1166. | Sub-Section-IVD -CIVIL WORKS | Clause no.25.02 | Excavations in hard rock shall be carried by Blasting if required. The contractor shall obtain license from the competant authorities for undertaking blasting works. | Bidder request client to take necessary statutory permissions required for Blasting from the concern authorities. Bidder has excluded these from their scope of work. | Bidder shall comply with technical specification requirement. |
| 1167. | Sub Section I-M1 | Clause 5.06.06 | Mist eliminator | Whether bidder can propose roof type ME with PP material | Bidder can propose roof type Mist Eliminators with the material specified in the Technical Specification. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section No. | Clause No. | Bid Specification Stipulation | Bidder's Query / Stipulation | NTPC Clarifications |
|---|---|---|---|---|---|
| 1168. | Sub Section I-M1 | Clause 5.03.02 | Oxidation Blower | The stoichiometric ratio of 2.5 was mostly used in the past for grid type of oxidation, now a day with new spargers, lower SR typically below 2 are in use, can we consider lower SR. Also whether we can offer 3 blowers (2W+1S) common for two units | Bidder shall comply with the requirements of Technical Specifications. |

| S.No | Vol No/Clause No | Page No. | Description of Bid Document | Queries/Suggestions | NTPC Clarifications |
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| S.No | Vol No/Clause No | Page No. | Description of Bid Document | Queries/Suggestions | NTPC Clarifications |
|---|---|---|---|---|---|
| 1 | SECTON -VI TECHNICAL SPECIFICATION, Clause: 3.14.03 | 1 | The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998 (Part 1) : 1992. The wind shield<br>shall be analysed for cases with and without flue liner loads. | NTPC to clarify wind shield design shall be performed as per IS 4998 (Part 1) : 1992 or IS 4998 (Part 1) : 2015. | Bidder shall comply to the requirements of technical specification. |
| 2 | SECTON -VI TECHNICAL SPECIFICATION, Clause: 3.14.03 | 2 | The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm. | NTPC to confirm the minimum thickness of shell shall be as per IS 4998(Part-1) or 500mm. | Bidder shall comply to the requirements of technical specification. |
| 3 | SECTON -VI TECHNICAL SPECIFICATION, Clause: 3.14.01 | 10 | | As there is no clarity regarding mini shell above roof level, it is proposed to extend the steel flu can above chimney roof with 2 mm thick Titanium / C-276 sheet over insulation as per clause 3.02.07 of SUB-SECTION·I·M1(Part-B) on external surface of the steel flu extended above roof. No RCC mini shell considered. NTPC to confirm. | Flue liner shall be provided as pe the requirements of technical Specification. There is no specific requirement of RCC mini-shell. |

# CLARIFICATION No.01 (TECHNICAL)
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| S.No | Vol No/Clause No | Page No. | Description of Bid Document | Queries/Suggestions | NTPC Clarifications |
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| 4 | Sr no 4 of the Table under clause 5.01.00 & discription of the clause of Sub section -V of Section VI- Part A | 8 | Wet Stack shall be designed as per guide lines of EPRI Revised Wet Stack Design Guide.<br><br>Flue Gas Velocity in Stack < 18 m/s | Table 2.1 of EPRI Wet Stack Design Guide reccommends maximum flue gas velocity for Alloy Liners as 16.8 m/s agaist NTPC specification of 18 m/s.<br>Plesae clarify as to what value of flue gas velocity shall be considered for Wet Stack Design. | Bidder shall comply with the requirements of Technical Specifications. |
| 5 | Clause no 5.02.01 and 5.02.02 of sub-section-V of Section VI -Part-A | 8 | Wet Stack Study consisting of 1:12 Physical flow Model, computational flow model for plume downwash analysis, physical or computational flow model for CEMS elevation flow performance shall be carried out by bidder. | Considering one liner one abosrber configuration specified by NTPC along with total number of Power Plant Units under LOT-1A, a very large number of studies are required to be carried out.<br>As time required for these studies is substantial , it is requested to remove the studies under the mentioned clauses from the scope of the bidder. | Bidder shall comply with the requirements of Technical Specifications. |
| 6 | Clause no 1.00.00 Sr. no 7-(iii), of sub-section-V of Section VI -Part-A | 1 | Design Point : H20 = 3.958 | It appears correct figure for moisture in design point is 13.958.<br>NTPC to confirm. | Refer necessary amendment in this regard. |
| 7 | Clause no 2.00.00 & 3.00.00, of sub-section-V of Section VI -Part-A | 3 | Meja-I 2x660 MW | MEJA-I, 2x660 MW power station is appearing in both 2.00.00 & 3.00.00 .NTPC to clarify Design Data for Meja-I project FGD system | Refer necessary amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section No. | Clause No. | Bid Specification Stipulation | Bidder's Query / Stipulation | NTPC Clarifications |
|---|---|---|---|---|---|
| 1169. | Part-A- Sub Section-II-A6 | Clause no.7.08- Page no.19 | Foundation System and Geotechincal Data- Type of Foundation system to be adopted- Open Foundation system. | The foundation design shall be based on final recommendations of geotechnical investigation report approved by Client during execution. Provision shall be made for appropriate compensation If any major variation in the soil data/ subsoil conditions if identified. | Bidder may refer Cl. No. 7.00.03. If bidder feels, data provided is not adequate, he may carry out geotechnical investigation for bidding purpose. Further, Bidder shall comply the provisions of Technical Specification. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section No. | Clause No. | Bid Specification Stipulation | Bidder's Query / Stipulation | NTPC Clarifications |
|---|---|---|---|---|---|
| 1170. | Sub-Section-IVD -CIVIL WORKS | Clause no.12.00 | RCC Roads & RCC Drains | Bidder understands that only approach roads along with drains on both sides shall be provided from the new structures of the proposed FGD. The main plant roads and drains shall be in the scope of the client. Please confirm. | Refer Scope of work. Refer clause 2.00.00 Section-VI, Part-A of technical specification |
| 1171. | Sub-Section-IVD -CIVIL WORKS | Clause no.13.00 | Gate Along Boundary Wall | Bidder understands that any works for construction of gate along boundary wall is excluded from the bidders scope of work. | Refer Scope of work. Refer clause 2.00.00 Section-VI, Part-A of technical specification. |
| 1172. | Sub-Section-IVD -CIVIL WORKS | Clause no.4.01 | Contractors scope shall include construction of necessary culverts below railway lines/ roads as per the railway/IRC standards and shall take approvals of railway culverts from the concerned railway authorities. | Bidder has considered RCC hume pipe culverts only below the approach roads in the scope of works for this package. Bidder has excluded the construction of culverts below railway lines and taking their approvals from necessary railway authorities. Bidder request client to kindly confirm. | Bidder shall comply with technical specification requirement. |
| 1173. | Sub-Section-IVD -CIVIL WORKS | Clause no.14.00 | The Storm Water drainage for any area under consideration shall be taken in to account the finished grade levels of the area. | Bidder has considered only the drains along the approach roads and garland drains around the proposed structures. These drains shall be connected to the nearest main plant drains with proper slopes. Please confirm. | Bidder's understanding is correct. |

# CLARIFICATION No.01 (TECHNICAL)
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| Sr. No. | Section No. | Clause No. | Bid Specification Stipulation | Bidder's Query / Stipulation | NTPC Clarifications |
|---|---|---|---|---|---|
| 1174. | Sub-Section-IVD -CIVIL WORKS | Clause no.25.02 | Excavations in hard rock shall be carried by Blasting if required. The contractor shall obtain license from the competant authorities for undertaking blasting works. | Bidder request client to take necessary statutory permissions required for Blasting from the concern authorities. Bidder has excluded these from their scope of work. | Bidder shall comply the provisions of Technical Specification. |
| 1175. | Sub Section I-M1 | Clause 5.06.06 | Mist eliminator | Whether bidder can propose roof type ME with PP material | Bidder shall comply with the requirements of Technical Specifications. |
| 1176. | Sub Section I-M1 | Clause 5.03.02 | Oxidation Blower | The stoichiometric ratio of 2.5 was mostly used in the past for grid type of oxidation, now a day with new spargers, lower SR typically below 2 are in use, can we consider lower SR. Also whether we can offer 3 blowers (2W+1S) common for two units | Bidder shall comply with the requirements of Technical Specifications. |
| 1177. | Extension | | | As explained during pre-bid meeting, requirement of site visits and overall complex nature of project, we request the bid submission date extension up to **17.10.2017** | Not a technical query. |

| S. No. | Section | Clause No | Page No. | Statement of Deviation/Part/ Chapter | Variations / Exceptions | NTPC Clarifications |
|---|---|---|---|---|---|---|
| B. | TECHNICAL DEVIATION | | | | | |

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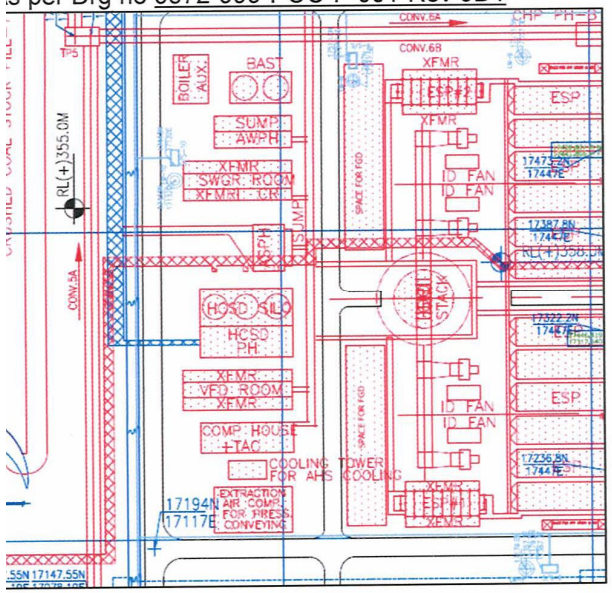
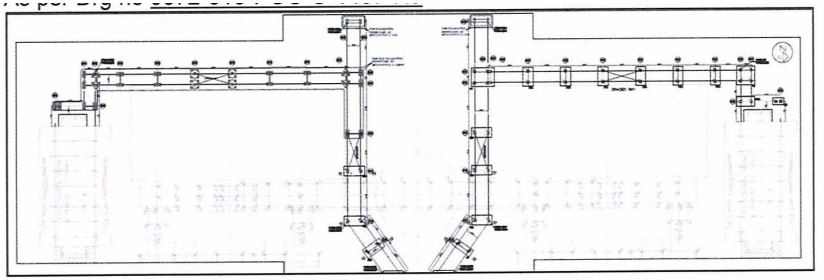
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| | | | | | | |
|---|---|---|---|---|---|---|
| 1178. | | | | Location of new low height wet stack | According to the technical specification, low height wet chimney shall be installed. However in the drawing, there is not enough space for new chimney. Please inform the location for wet chimney.<br>If treated flue gas from FGD system shall be exhausted via existing chimney instead of new stack, lining work for duct and existing chimney will be required. Please confirm the duct arrangement and clarify scope of lining work. | Bidder shall comply with the requirements of Technical Specifications. |
| 1179. | | | | Space for FGD system | According to the drawing, it is expected that there is not enough space for new FGD system. | Bidder shall comply with the requirements of Technical Specifications. |
| 1180. | Part-A-Sec-V | 2.00.00 | 3 of 26 | The flue gas desulphurization (FGD) system for MOUDA-Ⅱ 2 x 660MW, TANDA -Ⅱ 2 x 660MW, NABINAGAR-Ⅰ 2 x 660MW, MEJA-Ⅰ 2 x 660MW, & BARH- 3x 660MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below. | Please clarify which design requirements shall be applied to MEJA-Ⅰ 2 x 660MW project. | Refer necessary amendment in this regard. |
| | | 3.00.00 | 5 of 26 | The flue gas desulphurization (FGD) system for SOLAPUR-Ⅱ 2 x 660MW & MEJA-Ⅰ 2 x 660MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table below. | | |

| S. No. | Section/Part/chapter | Clause No | Page No. | Bid Specification | Clarification sought by the bidder | NTPC Clarifications |
|---|---|---|---|---|---|---|

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| | | | | | | |
|---|---|---|---|---|---|---|
| 1181. | SUB-SECTIONI LA3 PROJECT INFORMATION -GADARWARA- 1 2X800MW | | | DRG NO. 9572-999-POC-F-001 REV 5D1 GENERAL LAYOUT PLAN & 9572-31 5- | Cable trestle layout is different between cable trestle drawing and General Layout Plan:<br><br>s per Drg no 9572-999-POC-F-001-Rev 5D1<br>  <br><br>  <br>Please clarify, which one to follow. | Bidder to refer Amended GLP being issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| | | | | | | |
|---|---|---|---|---|---|---|
| 1182. | | | | Primary Crusher House | NTPC is requested to provide the following drawings:<br>1) Conveyor and trusses from ground Hopper<br>2) Drawing for primary crusher house plan and side view | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1183. | | | | Water source | NTPC is requested to confirm terminal point of clarified water | Provisions of Technical specification are clear. Bidder shall comply with the same. |

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1184. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | Trestles shown near to "Space for FGD" | Bidder wish to clarify that during their site visit, they have seen that the Trestles near "Space for FGD" is under construction, so Bidder understand that Employer will provide space in the existing/under construction trestles to install bidders supplied cables & pipes for FGD. | Stipulations, as given under Clause 14.00.00 Sub Section-III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles.<br>-Bidder shall comply with technical specification requirement clause no: -1.08.00.2 Sub Section- III-B, Section –VI, Part-A. |
| 1185. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | Pipe/Cable Trestles & ID Fan out duct supports arround FGD area | Bidder request employer to furnish the foundation drawings of ID Fan outlet ducts and Trestles installed arround FGD area for both Unit-1 & Unit-2. | Requested foundation drawings will be discussed with the successful bidders.<br>Bidder to refer Table 7 of Sub Section- II-A2 PROJECT INFORMATION (LARA-2x800MW) Section –VI, Part-A for pipe/cable trestle drawings. |
| 1186. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | ESP control room near FGD area for Unit-1 & Unit-2 | Bidder request Employer to furnish the foundation drawings of ESP control rooms (which is coming near to FGD area) under construction enabling Bid- | Requested foundation drawings will be discussed with the successful bidders. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | der to finalise the layout of FGD equipments. | |
| 1187. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | Existing ID Fan (2 nos. per Boiler) outlet ducts entering to Stack | As per Bidders site visit, 2 no. tapping (1 no. from each ID Fan outlet duct) per Boiler can be possible. Employer to confirm whether this is acceptable. | Bidder to carry out its own assessment during the site visit and offer a suitable design of the same. |
| 1188. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | Space For FGD | During Bidders site visit, it was observed that there are some Contractors site offices already existing in the Space marked for FGD and some Contractors offices/stores are made of Asbestos. Removal of these office spaces and asbestos shall be excluded from Contractors's scope. Employer is requested to confirm. Employer is also requested to furnish the clear leveled land (FGL)for the spaces marked for FGD. | Bidder to refer the revised GLP in amendments issued. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1189. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | Space for FGD in the Green Belt | During Bidders site visit, it was observed that there a Tree is falling in the Green Belt area (Space for FGD). Bidder understands that the cutting and transplantation of trees shall be in Employer scope and the same shall be completed before handover of site to Contractor. Employer is requested to confirm on Bidders understanding. | Bidder to refer the revised GLP in amendments issued. |
| 1190. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | 2 nos. Belt conveyor (1A & 1B) traveling from TP-2 to Crusher House | Bidder requests employer to furnsih the following detail of Conveyor 1A & 1B between TP-2 to Crusher House:<br>- Structural Arrangement Drawings of Galary & Supports& their Foundations<br>- GA of Conveyors and supporting foundations.<br>- Capacity of existing coal conveyors etc. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1191. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | Geotechnical Investigation Scheme(Clause-7.08.000- page 21 of 48) | | Soil Data and Foundation System | Bidder request Owner to provide the soil resitivity values for the FGD designated area. | Bidder may refer necessary Amendment. |
| 1192. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | Storage/Laydown area/Area for dumping of excavated material | During site visit, it has been observed that no area has been earmarked for laydown/storage/ excavated material dumping other than the areas identified for FGD. Bidder request Owner to please earmark areas at site for laydown/storage/ excavated material dumping. | Bidder to refer the revised GLP in amendments issued. |
| 1193. | SECTION – VI, PART-A | SUB-SECTION-II-A2 (Project Information-LARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9548-999-POM-F-001, Rev-6D0) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed with the successful bidder during detail engg.. |
| 1194. | SECTION – VI, PART-A | SUB-SECTION-II-A4 (Project Information-Darlipalli-2x800 MW) | GLP (Drawing No. 9549-999-POC-F-001, Rev-9) | | Trestles shown near to "Space for FGD" | Bidder wish to clarify that during their site visit, they have seen that the Trestles near "Space for FGD" is under construction, so Bidder understand that Employer | Stipulations, as given under Clause 14.00.00 Sub Section-III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | will provide space in the existing/under construction trestles to install bidders supplied cables & pipes for FGD. | Bidder shall comply with technical specification requirement clause no: - 1.08.00.2 Sub Section- III-B, Section –VI, Part-A. |
| 1195. | SECTION – VI, PART-A | SUB-SECTION-II-A4(Project Information-Darlipalli-2x800 MW) | GLP (Drawing No. 9549-999-POC-F-001, Rev-9) | | Space For FGD | During Bidders site visit, it was observed that there are some Contractors site offices already existing in the Space marked for FGD and some Contractors offices/stores are made of Asbestos. Removal of these office spaces and asbestos shall be excluded from Contractors's scope. Employer is requested to confirm. Employer is also requested to furnish the clear leveled land (FGL)for the spaces marked for FGD. | Bidder to refer the revised GLP in amendments issued. |
| 1196. | SECTION – VI, PART-A | SUB-SECTION-II-A4 (Project Information-Darlipalli-2x800 MW) | GLP (Drawing No. 9549-999-POC-F-001, Rev-9) | | Crusher House | Employer is requested to furnish the scheme/routing of limestone conveyong from coal crusher house to FGD area for better understanding. | Bidder may please refer to the layout drawing furnished with tender. Also Bidder may visit site for clarity. Accordingly Bidder may come up with feasible routing. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1197. | SECTION – VI, PART-A | SUB-SECTION-II-A4 (Project Information-Darlipalli-2x800 MW) | Geotechnical Investigation Scheme(Clause-7.08.000- page19 of 30) | | Soil Data and Foundation System | Bidder request Owner to provide the soil resitivity values for the FGD designated area. | Bidder may refer necessary Amendment. |
| 1198. | SECTION – VI, PART-A | SUB-SECTION-II-A4 (Project Information-Darlipalli-2x800 MW) | GLP (Drawing No. 9549-999-POC-F-001, Rev-9) | | Storage/Laydown area/Area for dumping of excavated material | During site visit, it has been observed that no area has been earmarked for laydown/storage/ excavated material dumping other than the areas identified for FGD. Bidder request Owner to please earmark areas at site for laydown/storage/ excavated material dumping. | Bidder to refer the revised GLP in amendments issued. |
| 1199. | SECTION – VI, PART-A | SUB-SECTION-II-A4 (Project Information-Darlipalli-2x800 MW) | GLP (Drawing No. 9549-999-POC-F-001, Rev-9) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed during the detail engg. with the successful bidder. |
| 1200. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage -I (3x660 MW) | GLP (Drawing No. 95558/9560-999-POC-F-001, Rev-8-D0) | | Space for FGD (650m x 131 m) | During Bidders site visit, it was observed that there are some Contractors site office, store is already exist in the Space marked for FGD (650m x 131m). Removal of these office spaces and asbestos shall be excluded | Bidder to refer the revised GLP in amendments issued. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | from Contractors's scope. Employer is requested to confirm.<br>Employer is requested to furnish the clear leveled land for the spaces marked for FGD. | |
| 1201. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage -I (3x660 MW) | GLP (Drawing No. 95558/9560-999-POC-F-001, Rev-8-D0) | | Space For FGD | During Bidders site visit, it was observed that there are some Contractors site offices already existing in the Space marked for FGD and some Contractors offices/stores are made of Asbestos. Removal of these office spaces and asbestos shall be excluded from Contractors's scope. Employer is requested to confirm.<br>Employer is also requested to furnish the clear leveled land (FGL)for the spaces marked for FGD. | Bidder to refer the revised GLP in amendments issued. |
| 1202. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage -I (3x660 MW) | GLP (Drawing No. 9558/9560-999-POC-F-001, Rev-8-D0) | | Trestles shown near to "Space for FGD" | Bidder wish to clarify that during their site visit, they have seen that the Trestles near "Space for FGD" is under construction, so Bidder | Stipulations, as given under Clause 14.00.00 Sub Section-III-A1 Section –VI, Part-A, shall be complied with w.r.t |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | understands that Employer will provide space in the existing/under construction trestles to install bidders supplied cables & pipes for FGD. | trestles.<br>Bidder shall comply with technical specification requirement clause no: - 1.08.00.2 Sub Section- III-B, Section –VI, Part-A. |
| 1203. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage -I (3x660 MW) | GLP (Drawing No. 95558/9560-999-POC-F-001, Rev-8-D0) | | Pipe/Cable Trestles, Conveyors Galary, Ash Water & Ash Slurry Pump houses etc. naer FGD area | Bidder request employer to furnish the elevation drawings & foundation drawings of Pipe/Cable Trestles, Conveyors Galary, Ash Water & Ash Slurry Pump houses etc. which is coming near FGD area and the FGD ducting needs to be routed through this. | Bidder to refer the revised GLP in amendments issued. |
| 1204. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage -I (3x660 MW) | GLP (Drawing No. 95558/9560-999-POC-F-001, Rev-8-D0) | | Space for FGD | During Bidders site visit, it was observed that there a Tree is falling in the Green Belt area (Space for FGD). Bidder understands that the cutting and transplantation of trees shall be in Employer scope and the same shall be completed before handover of site to Contractor. Em- | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | ployer is requested to confirm on Bidders understanding. | |
| 1205. | SECTION – VI, PART-A | SUB-SECTION-II-A10(Project Information-Barh STPP, Stage -I (3x660 MW) | GLP (Drawing No. 95558/9560-999-POC-F-001, Rev-8-D0) | | 2 nos. Belt conveyor (15A & 15B) traveling from TP-25 to Crusher House II | Bidder requests employer to furnsih the following deatil of Conveyor 15A & 15B between TP-25 to Crusher House II:- Structural Arrangement Drawings of Galary & Supports & their foundations- GA of Conveyors & their foundations- Capacity of existing coal conveyors etc. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1206. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage -I (3x660 MW) | GLP (Drawing No. 95558/9560-999-POC-F-001, Rev-8-D0) | | Space for FGD (220m x 25m) | This space (220mx25m) is falling near to the plant boundary railway line area. As the width of this space is 25m and the raft of new Stack will be more then 25mtr., this space can not be used for new wet stack. Bidder requests Employer to enmark additional space | Bidder to refer the revised GLP in amendments issued. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | (more than 35mtr width) where new wet stack can be erected. | |
| 1207. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage-I-3x660 MW) | Geotechnical Investigation Scheme(Clause-7.00.00- page10 of 30) | | Soil Data and Foundation System | Bidder request Owner to provide the soil resitivity values for the FGD designated area. | Bidder may refer necessary Amendment. |
| 1208. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage-I-3x660 MW) | GLP (Drawing No. 95558/9560-999-POC-F-001, Rev-8-D0) | | Storage/Laydown area/Area for dumping of excavated material | During site visit, it has been observed that no area has been earmarked for laydown/storage/ excavated material dumping other than the areas identified for FGD. Bidder request Owner to please earmark areas at site for laydown/storage/ excavated material dumping. | Bidder to refer the revised GLP in amendments issued. |
| 1209. | SECTION – VI, PART-A | SUB-SECTION-II-A10 (Project Information-Barh STPP, Stage-I-3x660 MW) | GLP (Drawing No. 95558/9560-999-POC-F-001, Rev-8-D0) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed with the successful bidder during the detail engg. stage. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1210. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar STPP-I, 3x660 MW) | GLP (Drawing No. 0370-999-POC-F-001, Rev-9) | | 2 nos. Belt conveyor (2A & 2B) traveling from PH-1 to Crusher House I | Bidder request employer to furnsih the following deatil of Conveyor 2A & 2B between PH-1 to Crusher House I:<br>- Structural ArranBID-DERment Drawings of Galary & Supports<br>- GA of Conveyors<br>- Capacity of existing coal conveyors etc. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1211. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar STPP-I, 3x660 MW) | GLP (Drawing No. 0370-999-POC-F-001, Rev-9) | | Pipe/Cable trusles traveling near FGD area | Bidder request Employer to furnish the Foundation drawing of Cable/pipe Trestles coming near ID Fan outlet duct entering to stack and near FGD area. | Bidder to refer Table 6 of Sub Section- II-A8 PROJECT INFORMATION (NABINAGAR STPP-I 3 X660MW) Section –VI, Part-A for pipe/cable trestle drawings. |
| 1212. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar STPP-I, 3x660 MW) | GLP (Drawing No. 0370-999-POC-F-001, Rev-9) | | Trestles shown near to "Space for FGD" | Bidder wish to clarify that during their site visit, they have seen that the Trestles near "Space for FGD" is under construction, so Bidder understand that Employer will provide space in the exist- | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles.<br>Bidder shall comply with technical specification re- |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | ing/under construction trestles to install bidders supplied cables & pipes for FGD. | quirement clause no: - 1.08.00.2 Sub Section- III-B, Section –VI, Part-A. |
| 1213. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar STPP-I, 3x660 MW) | GLP (Drawing No. 0370-999-POC-F-001, Rev-9) | | Space For FGD | During Bidders site visit, it was observed that there are some Contractors site office/store is already exist in the Space marked for FGD.<br>So Employer is requested to furnish the clear levelled land for the spaces marked for FGD. | Bidder to refer the revised GLP in issued amendments. |
| 1214. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar STPP-I, 3x660 MW) | Geotechnical Investigation Scheme(Clause-7.08.00- page19 of 31) | | Soil Data and Foundation System | Bidder request Owner to provide the soil resitivity values for the FGD designated area. | Bidder may refer necessary Amendment. |
| 1215. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar STPP-I, 3x660 MW) | GLP (Drawing No. 0370-999-POC-F-001, Rev-9) | | Storage/Laydown area/Area for dumping of excavated material | During site visit, it has been observed that no area has been earmarked for laydown/storage/ excavated material dumping other than the areas identified for FGD. Bidder | Bidder to refer the revised GLP in issued amendments. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | request Owner to please earmark areas at site for laydown/storage/ excavated material dumping. | |
| 1216. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar STPP-I, 3x660 MW) | GLP (Drawing No. 0370-999-POC-F-001, Rev-9) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed with the successful bidder during the detail engg. stage. |
| 1217. | SECTION – VI, PART-A | SUB-SECTION-II-A8(Project Information-Nabinagar TPP, 4x250 MW) | GLP (Drawing No. 0270-999-POC-F-001, Rev-6) | | Trestles shown near to "Space for FGD" | Bidder wish to clarify that during their site visit, they have seen that the Trestles near "Space for FGD" is under construction, so Bidder understand that Employer will provide space in the existing/under construction trestles to install bidders supplied cables & pipes for FGD. | Stipulations, as given under Clause 14.00.00 Sub Section-III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles.<br>Bidder shall comply with technical specification requirement clause no: - 1.08.00.2 Sub Section- III-B, Section –VI, Part-A. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1218. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar TPP, 4x250 MW) | GLP (Drawing No. 0270-999-POC-F-001, Rev-6) | | Space For FGD | During Bidders site visit, it was observed that there are some Contractors site offices already existing in the Space marked for FGD and some Contractors offices/stores are made of Asbestos. Removal of these office spaces and asbestos shall be excluded from Contractors's scope. Employer is requested to confirm. Employer is also requested to furnish the clear leveled land (FGL)for the spaces marked for FGD. | Bidder to refer the revised GLP in issued amendments. |
| 1219. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar TPP, 4x250 MW) | GLP (Drawing No. 0270-999-POC-F-001, Rev-6) | | 2 nos. Belt conveyor (2A & 2B) traveling from PH-1 to Crusher House | Bidder request employer to furnsih the following deatil of Conveyor 2A & 2B between PH-1 to Crusher House:<br>- Structural Arrangement Drawings of Galary & Supports & foundation<br>- GA of Conveyors & | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | foundation.<br>- Capacity of existing coal conveyors etc. | |
| 1220. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar TPP, 4x250 MW) | GLP (Drawing No. 0270-999-POC-F-001, Rev-6) | | Railway tracks between Crusher house & Space for FGD | Bidder wish to clarify that, if limestone shall be transferred from existing coal conveyors to FGD area, the convey-ors/slurry pipes needs to routed over the railway lines. So Employer is re-quested to furnish the guideline, if any, needs to be considered for this. Also Employer is request-ed to furnish the GA drawing of railways tracks coming between Coal conveyors (including CH) & FGD area. | Noted. Detailed drawings of existing facilities shall provided with the success-ful bidder. |
| 1221. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar TPP, 4x250 MW) | GLP (Drawing No. 0270-999-POC-F-001, Rev-6) | | Pipe/Cable trules near FGD area | Bidder request Employer to furnish the GA Draw-ings of pipe & cable tres-tles infront of the Stacks, | Bidder to refer Amended Project Information in-cluded in Table 6 of Sub Section- II-A 11 PROJECT |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | ID Fan outlet ducts along with associated foundation drawings etc. enabling Bidder to decide the duct layout from taping point to FGD area | INFORMATION (NABINAGAR TPP) Section –VI Part-A, being issued separately, for pipe/cable trestle drawings.<br><br>Requested drawings as ID Fan outlet ducts foundation drawings will be discussed with the successful bidder during the detail engg. stage. |
| 1222. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar TPP, 4x250 MW) | Geotechnical Investigation Scheme(Clause-7.08.00- page 20 of 29) | | Soil Data and Foundation System | Bidder request Owner to provide the soil resitivity values for the FGD designated area. | Bidder to refer necessary amendment in this regard. |
| 1223. | SECTION – VI, PART-A | SUB-SECTION-II-A8 (Project Information-Nabinagar TPP, 4x250 MW) | GLP (Drawing No. 0270-999-POC-F-001, Rev-6) | | Storage/Laydown area/Area for dumping of excavated material | During site visit, it has been observed that no area has been earmarked for laydown/storage/ excavated material dumping other than the areas identified for FGD. Bidder request Owner to please earmark areas at site for | Bidder to refer the revised GLP in issued amendments. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | laydown/storage/ excavated material dumping. | |
| 1224. | SECTION – VI, PART-A | SUB-SECTION-II-A8(Project Information-Nabinagar TPP, 4x250 MW) | GLP (Drawing No. 0270-999-POC-F-001, Rev-6) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed with the successful bidder during the detail engg. stage. |
| 1225. | SECTION – VI, PART-E | Tender Drawing List-Electrical Single Line Diagram of FGD Package | Drawing No. 0011-109-POE-J-001A-E, Rev-A | | 11 KV KV HT SWGR Panel | Bidder wish to clarify that during their site visit, they have found only 6.6 KV HT SWGR at the main TG building instead of 11 KV. Bidder request Employer to furnish the revised SLD for BRBCL site. | Refer amended Tender SLD. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1226. | SECTION – VI, PART-A | SUB-SECTION-II-A5 (Project Information-MOUDA Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9561/9575-999-POC-F-001, Rev-11D0) | | Railways tracks between Crusher house & Space for FGD | Bidder wish to clarify that, if limestone will be transferred from existing coal conveyors to FGD area, which is far away from FGD area, the conveyors/slurry pipes needs to routed over the railway lines & road. So Employer is requested to furnish the following:<br>1. Specific guideline for crossing the rail track , if any,<br>2. Employer is requested to furnish the GA drawing of railways tracks coming between Coal conveyors (including CH) & FGD area.<br>3. Employer is requested to furnish the GA drawings or details from conveyer 15 A/B to CH2, Structural Arrangement Drawings of Galary & | Same will be discussed with the successful bidder during the detail engg. stage. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | Supports along with associated foundations and Capacity of existing coal conveyors etc. | |
| 1227. | SECTION – VI, PART-A | SUB-SECTION-II-A5 (Project Information-MOUDA Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9561/9575-999-POC-F-001, Rev-11D0) | | Space for Laydown, pre-assemblies & site office | Bidder requests owner to also allocate space for Laydown , Site Office and Pre-assembly near allocated FGD space as per GLP. | Bidder to refer the revised GLP in issued amendments. |
| 1228. | SECTION – VI, PART-A | SUB-SECTION-II-A5 (Project Information-MOUDA Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9561/9575-999-POC-F-001, Rev-11D0) | | First Aid Center | Bidder understands that the existing First-Aid Center facilities shall be extended to Bidder's Site Personnel. | Bidder to refer cl.no. 28.05.00 of section VI part D in this regard. |
| 1229. | SECTION – VI, PART-A | SUB-SECTION-II-A5 (Project Information-MOUDA Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9561/9575-999-POC-F-001, Rev-11D0) | | Fire Tender | Bidder understand that Owner shall extend the Fire Tender services in case of Fire emergency. | Bidder to refer cl.no. 30.00.00 of section VI part D in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1230. | SECTION – VI, PART-A | SUB-SECTION-II-A5 (Project Information-MOUDA Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9561/9575-999-POC-F-001, Rev-11D0) | | Pipe rack /Cable Trestles near FGD area | Bidder request Employer to furnish the GA Drawings of pipe rack & cable Trestles infront of the Stack and ID Fan outlet ducts etc. enabling us to decide the duct layout from taping point to FGD area and also advise if any space available so that same can be utilized for FGD | Bidder to refer drawings at S.No 6 and 7 in Page no 40/40 Sub Section- II-A5 PROJECT INFORMATION (MOUDA-II 2x660MW) Section –VI, Part-A for pipe/cable trestle drawings.<br><br>Requested documents will be discussed with the successful bidder during the detail engg. stage. |
| 1231. | SECTION – VI, PART-A | SUB-SECTION-II-A5 (Project Information-MOUDA Super Thermal Power Project-2x660 MW) | Geotechnical Investigation Scheme(Clause-7.08.00- page 20 of 40) | | Soil Data and Foundation System | Bidder request Owner to provide the soil resitivity values for the FGD designated area. | Bidder may refer Amendment . |
| 1232. | SECTION – VI, PART-A | SUB-SECTION-II-A5 (Project Information-MOUDA Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9561/9575-999-POC-F-001, Rev-11D0) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed with the successful bidder during the detail engg. stage. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1233. | SECTION – VI, PART-A | SUB-SECTION-II-A3(Project Information-GADARWARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9572-999-POC-F-001, Rev-5D1) | | Drawings / details required for conveyer 2A / 2B, CRH & TP3 and conveyer 4 A /B | Bidder wish to clarify that, if limestone shall be transferred from existing coal conveyors to FGD area, So Employer is requested to furnish the following:1. Employer is requested to furnish the GA drawing or details from conveyer 2A / 2B, CRH & TP3 and conveyer 4 A /B, Structural Arrangement Drawings of Galary & Supports along with associated foundations and Capacity of existing coal conveyors etc. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1234. | SECTION – VI, PART-A | SUB-SECTION-II-A3 (Project Information-GADARWARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9572-999-POC-F-001, Rev-5D1) | | Space for Laydown, pre-assemblies & site office | Bidder requests owner to also allocate space for Laydown , Site Office and Pre-assembly near allocated FGD space as per GLP. | Bidder to refer the revised GLP in issued amendments. |
| 1235. | SECTION – VI, PART-A | SUB-SECTION-II-A3 (Project Information-GADARWARA Super | GLP (Drawing No. 9572-999-POC-F-001, Rev-5D1) | | Space for FGD | Bidder understand that allocated space for FGD near chimney is not suffi- | Bidder to refer Amended GLP being issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | Thermal Power Project-2x800 MW) | | | | cient and some space in-front of TP3 and Conveyer 4 A/B is available. Employer is requested to furnish the clear & levelled space there. | Bidder to also refer TOPOGRAPHICAL Survey drawing provided in the project information chapter. |
| 1236. | SECTION – VI, PART-A | SUB-SECTION-II-A3 (Project Information-GADARWARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9572-999-POC-F-001, Rev-5D1) | | First Aid Center | Bidder understands that the existing First-Aid Center facilities shall be extended to Bidder's Site Personnel. | Bidder to refer cl.no. 28.05.00 of section VI part D in this regard. |
| 1237. | SECTION – VI, PART-A | SUB-SECTION-II-A3 (Project Information-GADARWARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9572-999-POC-F-001, Rev-5D1) | | Fire Tender | Bidder understand that Owner shall extend the Fire Tender services in case of Fire emerBIDDERncy. | Bidder to refer cl.no. 30.00.00 of section VI part D in this regard. |
| 1238. | SECTION – VI, PART-A | SUB-SECTION-II-A3 (Project Information-GADARWARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9572-999-POC-F-001, Rev-5D1) | | Cable Trestles from ESP control room near FGD area | As per current site status, cable Trestles & cable laying from ESP control room for unit #1 & 2 and infront ogf chimney yet not installed. The allocated space near chimney for FGD is nearly 25 mts x | Bidder to refer Amended GLP being issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | 106 mts both sides which is not sufficient to place FGD system. Employer is requested to re-locate the Cable Trestles towards either road or ID fan duct side so that a clear space widht of around 40 mts can utilized for FGD system. Employer is requested to confirm. | |
| 1239. | SECTION – VI, PART-A | SUB-SECTION-II-A3 (Project Information-GADARWARA Super Thermal Power Project-2x800 MW) | GLP (Drawing No. 9572-999-POC-F-001, Rev-5D1) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed with the successful bidder during the detail engg. stage. |
| 1240. | SECTION – VI, PART-A | SUB-SECTION-II-A6 (Project Information-Solapur Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Drawings / details required | Bidder request employer to furnish the foundation drawings of ID Fan outlet ducts and pipe/cable Trestles installed ESP-CR of unit 1 to ESP-CR of Unit 2 and Pipe/cable trestle coming from boiler near | Requested foundation drawings will be discussed with the successful bidder during the detail engg. stage.<br><br>Bidder to refer Table 7 of Sub Section- II-A 6 PRO- |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | the existing 275 mtr Stack. | JECT INFORMATION (SOLAPUR 2X660MW) Section –VI Part-A, for Pipe/cable trestle drawings. |
| 1241. | SECTION – VI, PART-A | SUB-SECTION-II-A6 (Project Information-Solapur Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Space for FGD (35X1000 mtr) as shown near Aux boiler | At present temporary 11 KVA line and transformer is available in this area. Employer is requested to furnish the clear levelled land for the spaces marked for FGD. | Bidder to refer the revised GLP in issued amendments. |
| 1242. | SECTION – VI, PART-A | SUB-SECTION-II-A6(Project Information-Solapur Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Are marked as "Laydown & pre-assembly" between 500N/1165E and 500N/1527E. | Bidder request employer to allow this area for installation of FGD equipment's | Laydown and assembly area is in space identified for Stage-II which cannot be used. |
| 1243. | SECTION – VI, PART-A | SUB-SECTION-II-A6 (Project Information-Solapur Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Road behind the existing stack. | Bidder wish to clarify that after taking flue gas tapping for FGD from existing flue gas duct to Stack, FGD flue gas duct supports may fall on both side of footpath along the | Bidder to refer the revised GLP in issued amendments. |

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | road. | |
| 1244. | SECTION – VI, PART-A | SUB-SECTION-II-A6 (Project Information-Solapur Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Limestone handling system | If Employer wishes to use limestone handling system by using existing WT,in that case employer is requested to share the conveyor detail drawings from UGTP-1 to CH, including detail drawing of UGTP-1. along with the associated foundations. | Same will be discussed with the successful bidder during the detail engg. stage. |
| 1245. | SECTION – VI, PART-A | SUB-SECTION-II-A6 (Project Information-Solapur Super Thermal Power Project-2x660 MW) | Geotechnical Investigation Scheme(Clause-7.08.00- page 19 of 31) | | Soil Data and Foundation System | Bidder request Owner to provide the soil resitivity values for the FGD designated area. | Bidder may refer Amendment . |
| 1246. | SECTION – VI, PART-A | SUB-SECTION-II-A6 (Project Information-Solapur Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Storage/Laydown area/Area for dumping of excavated material | During site visit, it has been observed that no area has been earmarked for laydown/storage/ excavated material dumping | Bidder to refer the revised GLP in issued amendments. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | other than the areas identified for FGD. Bidder request Owner to please earmark areas at site for laydown/storage/ excavated material dumping. | |
| 1247. | SECTION – VI, PART-A | SUB-SECTION-II-A6 (Project Information-Solapur Super Thermal Power Project-2x660 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed with the successful bidder during the detail engg. stage. |
| 1248. | SECTION – VI, PART-A | SUB-SECTION-II-A1 (Project Information-Kudgi Super Thermal Power Project-3x800 MW) | GLP (Drawing No. 9573-999-POC-F-001, Rev-6D1) | | Unit 2 & 3 ID Fan outlet ducts to existing stack. Pipe/Cable Trestles near Unit #2 and 3 common Stack. | Bidder request employer to furnish the foundation drawings of ID Fan outlet ducts and pipe/cable Trestles installed near the existing common stack of Unit 2 & 3 . | Requested foundation drawings will be discussed with the successful bidders.<br>Bidder to refer Table 7 of Sub Section- II-A1 PROJECT INFORMATION (KUDGI 3X800MW) Section –VI Part-A for Pipe/cable trestle drawings. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1249. | SECTION – VI, PART-A | SUB-SECTION-II-A1 (Project Information-Kudgi Super Thermal Power Project-3x800 MW) | GLP (Drawing No. 9573-999-POC-F-001, Rev-6D1) | | Space for FGD near the Aux. Boiler | At present temporary neutralization pond and acid pond is constructed in the proposed FGD area. Employer is requested to furnish the clear levelled ,compacted land for the spaces marked for FGD. | Bidder to refer the revised GLP in issued amendments. |
| 1250. | SECTION – VI, PART-A | SUB-SECTION-II-A1 (Project Information-Kudgi Super Thermal Power Project-3x800 MW) | GLP (Drawing No. 9573-999-POC-F-001, Rev-6D1) | | Limestone handling system | If Employer wishes to use limestone handling system by using existing WT,in that case employer is requested to share the conveyor detail drawings from WT to CH including detail drgs of all TP and pent house coming in between WT & CH. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1251. | SECTION – VI, PART-A | SUB-SECTION-II-A1(Project Information-Kudgi Super Thermal Power Project-3x800 MW) | Geotechnical Investigation Scheme(Clause-7.08.00- page 19 of 38) | | Soil Data and Foundation System | Bidder request Owner to provide the soil resitivity values for the FGD designated area. | Bidder may refer Amendment in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1252. | SECTION – VI, PART-A | SUB-SECTION-II-A1 (Project Information-Kudgi Super Thermal Power Project-3x800 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Storage/Laydown area/Area for dumping of excavated material | During site visit, it has been observed that no area has been earmarked for laydown/storage/ excavated material dumping other than the areas identified for FGD. Bidder request Owner to please earmark areas at site for laydown/storage/ excavated material dumping. | Bidder to refer the revised GLP in issued amendments. |
| 1253. | SECTION – VI, PART-A | SUB-SECTION-II-A1 (Project Information-Kudgi Super Thermal Power Project-3x800 MW) | GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0) | | Underground substructures, sewer pipes, water pipes, cables etc around the FGD | Bidder request Owner to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area . | Same will be discussed with the successful bidder during the detail engg. stage. |
| 1254. | SECTION – VI, PART-A | Subsection-III-D Civil | 1.06.00 | 2 of 4 | Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing | Bidder understand that Uniformed Finished ground level will be arranged by Employer (at NTP) for the area's allocated for FGD (Space for FGD mentioned in the layout drawing) Employer is requested to | Site levelling shall be done by Owner as per the levels specified in GLP in tender document. Only site clearance and minor grading is in bidder's scope. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | confirm on Bidders understanding. | |
| 1255. | GENERAL POINT | | | | Employers Hostels/guest house | Employer is requested to allow their existing hostels/gust house on chargable basis. | This may not be possible , however during the execution stage the same canbe discussed with our site. |
| 1256. | SECTION – VI, PART-B | Subsection-IV-D Civil Works | 39.00.00 | 65 of 69 | Sand aggregate for Construction | | Query is not clear. |
| 1257. | GENERAL POINT | | | | Topographical Survey drawing | Bidder request topographical survey drawing in Autocad format of all proposed FGD site.. | Bidder to refer necessary amendment in this regard. |
| 1258. | GENERAL POINT | | | | Area Drainage Study report | Bidder request Owner to furnish Area Drainage Study report for planning the drainage in the area earmarked for FGD facilities of all proposed site. | Bidder to refer the revised GLP in issued amendments. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | Part | Sub-section | Clause no. | Page | | | |
| 1259. | SECTION – VI, PART-E | Tender Drawing List-Electrical Single Line Diagram of FGD Package | Drawing No. 0011-109-POE-J-001A-E, Rev-A | | General Notes: Point no. 11:<br>Panel being used for feeding of CHP/AHP HT Transformers..... | During site visit of all projects, it was observed that separate 11 KV HT SWGR's are available in for CHP & AHP. So Bidder understand that either CHP or AHP SWGR needs to be modified to connect the FGD new TIE SWGR not both (AHP & CHP) needs to be modified. Employer is requested to confirm on Bidders understanding. | Refer amended tender SLD. |
| 1260. | SECTION – VI, PART-E | Tender Drawing List-Electrical Single Line Diagram of FGD Package | Drawing No. 0011-109-POE-J-001A-E, Rev-A | | Laying of cables between main 11 KV HT SWGR & FGD new TI SWGR, CHP/AHP SWGR | Bidder wish to clarify that during their site visits, they have seen the empty Cable Trestles between 11 KV HT SWGR (TG building) & FGD, CHP/AHP areas.<br>Bidder understand that Employer will provide space in the existing/under construction trestles to install bidders | Refer amended tender SLD.<br>-Bidder shall comply with technical specification requirement clause no: -1.08.00.2.However bidder may visit the project in order to get itself acquainted with existing electrical of plant. GLP of respective plants has already been attached. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
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| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | | supplied cables for FGD and Bidder will not install any new Trestles for the same .<br>Employer is requested to confirm on Bidders understanding. | |
| 1261. | SECTION – VI, PART-A | SUB-SECTION-V SALIENT DESIGN DATA & SIZING | 1.00.00, 2.00.00, 3.00.00, 4.00.00 | 2 OF 26, 4 OF 26, 6 OF 26, 8 OF 26 | HCL (PPM-WET): 45 for both guarnatee & design condition<br>HF (ppm-wet): 12 for both guarantee and design condition | | Query is not clear. |
| 1262. | SECTION – VI, PART-A | SUB-SECTION-IV TERMINAL POINTS AND EXCLUSION | 1.08.00 | 2 OF 3 | Waste water :<br>..... pH shall be 7.0 (approx) and temperature shall be <50 deg C | | Query is not clear. |
| 1263. | SECTION – VI, PART-A | SUB-SECTION-II-A5 PROJECT INFORMATION (MOUDA-II 2X660 MW) | ANNEXURE-II | 24 OF 40 | Climataological table for MSL, Ambient temperature... | | Query is not clear. |
| 1264. | SECTION – VI, PART-A | SUB-SECTION-II-A9 PROJECT INFORMATION (MEJA TPP-I 2X660 MW) | ANNEXURE-II | 22 OF 36 | Climataological table for MSL, Ambient temperature... | | Query is not clear. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
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| | Part | Sub-section | Clause no. | Page | | | |
| 1265. | SECTION – VI, PART-A | SUB-SECTION-II-A6 PROJECT INFOR-MATION (SOLAPUR 2X660 MW) | ANNEXURE-II | 23 OF 31 | Climataological table for MSL, Ambient tempera-ture... | | Query is not clear. |
| 1266. | SECTION – VI, PART-A | SUB-SECTION-II-A10PROJECT INFOR-MATION (BARH STPP STABIDDER-I 3X660 MW) | ANNEXURE-II | 21 OF 30 | Climataological table for MSL, Ambient tempera-ture... | | Query is not clear. |
| 1267. | SECTION – VI, PART-A | SUB-SECTION-II-A7 (Project Information-Tanda TPP, Stage-II -2x660 MW) | GLP (Drawing No. 9562-999-POC-F-001, Rev-8D1) | | Unit 5 & 6 ID Fan outlet ducts to existing stack. Pipe/Cable Trestles near Unit #5 and 6 common Stack. | Bidder request employer to furnish the foundation drawings of existing chimney, ID Fan outlet ducts and pipe/cable Trestles installed near the existing common stack of Unit 5 & 6 . | Bidder to refer Table pro-vided at Page 33/33 of Sub Section- II-A7 PROJECT INFORMATION (TANDA-II 2X660MW) Section –VI Part-A for Pipe/cable tres-tle drawings.<br><br>Requested foundation drawings will be discussed with the successful bidder during the detail engg. stage. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
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| | Part | Sub-section | Clause no. | Page | | | |
| 1268. | SECTION – VI, PART-A | SUB-SECTION-II-A7 (Project Information- Tanda TPP, Stage-II -2x660 MW) | GLP (Drawing No. 9562-999-POC-F-001, Rev-8D1) | | Limestone & Gypsum handling system | Employer is requested to share the conveyor detail drawings from WT to CH including detail drgs of all TP and pent house coming in between WT & CH. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1269. | SECTION – VI, PART-A | SUB-SECTION-II-A7 (Project Information- Tanda TPP, Stage-II -2x660 MW) | GLP (Drawing No. 9562-999-POC-F-001, Rev-8D1) | | Space for FGD in the Green Belt | During Bidders site visit, it is observed that there are trees coming in the Green Belt area (Space for FGD), so Bidder understand that the cutting of trees is in Employer scope. Employer is requested to confirm on Bidders understanding. | Bidder to refer the revised GLP in issued amendments. |
| 1270. | SECTION – VI, PART-A | SUB-SECTION-II-A7 (Project Information- Tanda TPP, Stage-II -2x660 MW) | GLP (Drawing No. 9562-999-POC-F-001, Rev-8D1) | | Soil Report & Borewell Details | Bidder request employer to provide the soil report and borewell details for alloted space for FGD | For Borelog details, bidder may refer Project information chapter furnished in Technical Specification for Tanda STPP. |
| 1271. | SECTION – VI, PART-A | SUB-SECTION-II-A9 (Project Information- Meja TPP, Stage-I -2x660 MW) | GLP (Drawing No. 0360/0361-999-POC-F-001, Rev-6D0) | | A) Unit 1 & 2 ID Fan outlet ducts to existing stack. B )Pipe/Cable Trestles near Unit #1 and 2 | Bidder request employer to furnish the foundation drawings of existing chimney, ID Fan outlet ducts and pipe/cable | Requested foundation drawings will be discussed with the successful bidder.<br><br>Bidder to refer Table 6 of |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl. No. | Specification Reference | | | | Employer (NTPC) Specification | Bidder Requested Clarification | NTPC Clarifications |
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| | Part | Sub-section | Clause no. | Page | | | |
| | | | | | common Stack. | Trestles installed near the existing common stack of Unit 1 & 2. | Sub Section- II-A9 PROJECT INFORMATION (MEJA 2X660MW) Section –VI Part-A, for Pipe/cable trestle drawings. |
| 1272. | SECTION – VI, PART-A | SUB-SECTION-II-A9 (Project Information-Meja TPP, Stage-I -2x660 MW) | GLP (Drawing No. 0360/0361-999-POC-F-001, Rev-6D0) | | Limestone & Gypsum handling system | Employer is requested to share the conveyor detail drawings from WT to CH including detail drgs of all TP and pent house coming in between WT & CH. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1273. | SECTION – VI, PART-A | SUB-SECTION-II-A9 (Project Information-Meja TPP, Stage-I -2x660 MW) | GLP (Drawing No. 0360/0361-999-POC-F-001, Rev-6D0) | | Soil Report & Borewell Details | Bidder request employer to provide the soil report and borewell details for alloted space for FGD | Bidder may refer Amendment. |
| 1274. | | | | | | What Size Limestone Incoming? | Technical specifications are clear in this regard. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
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| 1275. | Section-VI Part-B Sub Section-I-M1 (FGD) | 5.06.11 | 19 of 51 | The absorber vessel shall be made of minimum 7 mm thick carbon steel. The absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. | NTPC is requested to consider the following option for Absorber. " Cementitious Grouted Liner Plate over a Trowel-on Membrane ("Tile linings") over mild steel or a Liner Plate with RCC Absorber. A Wet Flue Gas Desulfurization ("WFGD") absorber requires an appropriate long-lasting lining to resist abrasion and corrosion resulting from the operating conditions within the WFGD absorber and the tile lining are widely accepted for over 25 years in USA and total WFGD units installed with Tile Linings are around 50,000 MW. The Tile Lining materials will be selected and designed by the Manufacturer to meet the criteria of WFGD and also these linings should have operational history in WFGD."<br><br>NTPC to confirm the acceptability of the above. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| 1276. | Section-VI Part-B Sub Section-I-M7 ZERO LIQUID DISCHARGE SYSTEM | 22-d | 14 of 32 | **Chemical feed pump suction piping,tubing and fittings** Size-1/2 inch OD minimum | NTPC is requested to accept minimum 1/4" OD tube. | This shall be finalized during detail engineering. |
| 1277. | Section-VI Part-B Sub Section-I-M7 ZERO LIQUID DISCHARGE SYSTEM | 3.01.00 | 3 of 32 | The Clarifier outlet will be fed to the mechanical vapor recompression (MVR), Brine Concentrator and Crystallizer system. | The Process flow diagram shows Steam Driven Crystallizer whereas write up calls for MVR.NTPC to clarify | As mentioned in Cl. No. 2.00.00 D, Sub-section I-M7, Part-B, Auxiliary steam if required shall be provided by owner for start-up condition only. For continuous duty, Bidder to design the various systems considering power driven equipment and the same shall be considered in power guarantee. |
| | Section-VI Part-E Tender Drawings | Process flow diagram for Crystallizer system Drg No-0011-109-POM-A-005(SHT-3 of 3) | | Steam Driven Crystalizer | | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| 1278. | Amendment No. 1 to Technical Specification (Section VI)<br><br>Section VI Part A/ SUB-SECTION I / Intent of Specification | 1.01.01 | 2 of 19 | (New Clause added)<br>Government of India has launched "Make in India" initiative to transform India into a global design and manufacturing hub. Accordingly, to promote manufacturing within India, the import content in Flue Gas Desulphurisation (FGD) System package has been restricted to 30% of the total Supply value quoted by Bidder in Price Schedule-1 plus Schedule-2. Bidder shall ensure that it does not import more than 30% of its Supplies and shall manufacture/ source equipment/ components from within India to meet the aforesaid requirement. | Owner vide Amendment no. 1 has restricted import content to 30% of the total supply value in order to promote "Make in India" initiative. The intent herein, as understood, is to maximise the supply from within India.<br><br>As per tender specification, *'the absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining/ cladding/ wall paper of Alloy C276 / Alloy 59 or better material'*. These lining materials are exotic in nature, with voluminous requirement and no suppliers are available in India who can manufacture & supply the same. Majority of import content value is attributable to these lining mate- | Bidder to refer clarifications being issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
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| | Amendment No.01 to Bid Data Sheets (BDS): Section-III | ITB 26.4 | | 26.4.1 LF Component (CIF price quoted in Schedule-1 plus CIF value of Import content of Ex-works price included in Schedule-2)quoted by Bidder, shall in no case be more than 30% of the total Supply value quoted by Bidder in Price Schedule-1 plus Price Schedule-2. | rials and we expect it to go beyond 30% of the total supply cost.<br><br>To meet Owner's requirement of import restriction and support "Make in India" inititative, Bidder proposes use of Flake glass (FLRP) lining (manufactured & supplied by Indian suppliers) inside the absorber oxidation tank, absorber tower & absorber outlet duct. Kinldy confirm. FLRP lining has been extensively used by Bidder's Collaborator world wide and is already a proven design for the intended application. Bidder may submit the references of global installations in case required by Owner for the necessary assessment. | |
| 1279. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.02.00 | 1 of 3 | One tapping from the common Flue Gas Duct going towards the existing Chimney (in case of twin flue chimney). No load of duct shall be transmitted on the Employers facilities. | Bidder proposes have an additional option of taking one tapping each for each booster fan from existing flue gas duct (from ID fan to existing chimney) for both single flue chimney and twin flue chimney. NTPC is requested to confirm. | Bidder shall comply with the requirements of Technical Specifications. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| 1280. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.05.00 | 2 of 3 | For FGD system, Contractor shall take a tap off suitably from the existing CW blow down header available near the CW pump house. The pressure available at TP will be 1.9 Ksc (gauge) wrt FGL (approx .. ). | Bidder proposes that the Process water tap off line from the CW blow down header upto the identified FGD space shall be<br>a) Buried under ground pipe.<br>b) Supported on the Owner Pipe rack.<br>NTPC is requested to confirm the same. | Shall be finalized during the course of detail engineering. |
| 1281. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.03.00 | 1 of 3 | Contractor shall take a tap off suitably from the existing Aux. steam header ( Pr. 16 ata, Temp-21 0 deg. C) available at BC bay below dearator floor. | Bidder proposes to have the tap off for Aux. steam at a location adjacent to the identified FGD area. NTPC is requested to confirm the same. | Provisions of Technical specification<br>are clear. Bidder shall comply with the same. |
| 1282. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.03.00 | 1 of 3 | The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package. | In case, if any of the existing structure is used for supporting utility lines, cables or equipments of FGD facility then NPTC shall provide all required documents of existing structure for verification and validiation for structural stability. NTPC is requested to confirm the same. | Same will be discussed with the successful bidder during the detail engg. stage. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| 1283. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.03.00 | 1 of 3 | The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package. | Bidder proposes to use the vacant space / trays available in existing cable trestle. NTPC to kindly confirm. | Specification requirement is clear under the referred cl.no. 1.08.00 & related clauses. . Bidder shall comply with the specification requirements. |
| 1284. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.03.00 | 1 of 3 | The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package. | Bidder proposes to use the vacant space / trays available in existing SWGR cable gallery. NTPC to kindly confirm. | Specification requirement is clear under the referred cl.no. 1.08.00 & related clauses. . Bidder shall comply with the specification requirements. |
| 1285. | Section VI, Part A, Sub Section III-A5 Limestone & Gypsum handling plants. | 1.00.00 | 1 of 6 | ..... all the equipment of Lime Stone Handling Plant & Gypsum Handling plant to be installed for FGD Package..... | NTPC is requested to identify the desired location of limestone and gypsum handling facilities or allow the bidder to place the location of the limestone and gypsum handling facilities based on feasibility suitable to bidder. NTPC is requested to confirm the same. | Bidder to refer the revised GLP in issued amendments. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
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| 1286. | BARH | - | - | - | Space allocated for FGD area is currently being utilised by STG contractor for laydown area. Bidder requests NTPC to confirm that this identified space shall be available completely clear of any obstructions to the Bidder at the time of awarding of contract. | Bidder to refer the revised GLP in issued amendments. |
| 1287. | 2X800MW DARLIPALI - GLP | - | - | 2X800MW DARLIPALI - FGD area identified in GLP drawing | The space identified for FGD area is adjacent to earthen bund of lagoon-1 and hence may not be suitable for controlled blasting for the purpose of excavation. Alternatively, bidder proposes to use the SG Contractor Space for FGD facilities. NTPC is requested to confirm the same. | Bidder to refer the revised GLP in issued amendments. |
| 1288. | BARH | - | - | FGD space identified in GLP | Bidder requests NTPC to cleary identify the space / area allocations in GLP for FGD facilities envisaged respectively for Stage 1 and Stage 2. | Bidder to refer Amended GLP being issued separately. |
| 1289. | BARH | - | - | FGD space identified in GLP | The identified area is the GLP is not sufficient for the FGD facilities, hence Bidder request NTPC to confirm whether the spaces identified under Laydown area, Temporary storage area for BTG contractors can be used for FGD facilities. | Bidder to refer the revised GLP in issued amendments. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
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| 1290. | General - All Sites | - | - | FGD space identified in GLP | At the identified location for FGD facilites in GLP, NTPC is requested to provide the area free from any temporary structure (super structure and foundation) and the Land to be graded upto FGL. Kindly confirm. | Bidder to refer the revised GLP in issued amendments. |
| 1291. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.01.00 | 1 of 3 | The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package. | As per tender terminal point information, all other utility pipe lines (Except process water) shall be tapped off along C row near CD bay rack. Bidder proposes to use client's pipe/cable rack for routing FGD Scope pipes/cables or else these tap offs shall be taken from client's pipe rack which is nearer to proposed FGD package. NTPC is requested to confirm. | Provisions of Technical specification<br>are clear. Bidder shall comply with the same. |
| 1292. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.08.00 | 2 of 3 | FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank, and 300 mm above FFL in HCSD Silo Area. | For terminating the waste water pipes near HCSD mixing tanks, bidder proposes to use the existing pipe rack available for routing and supporting the pipes. NTPC is requested to confirm the same. | Same will be discussed with the successful Bidder on case to case project specific basis. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
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| 1293. | MEJA | - | - | FGD space identified in GLP | Based on inputs received during the site visit at NTPC Meja, 7 nos of spaces / area are available for FGD facilities. Out of which only 1 is marked in the GLP drawing. Following are the remaining 6 areas.<br>1) 65x45: East of unit 1 ESP and pipe rack<br>2) 20x75: East of unit 1 ESP SWGR and pipe rack<br>3) 15x75: South of ID Fan duct and ESP cable rack.<br>4) 15x75: South of ID Fan duct and ESP cable rack.<br>6) 73x63: West of O&M Stores.<br>7) Polygon area 553 x 455: South of Stage 2 crushed coal stock pile-8 and north of Conveyor 1A/1B and 29A/29B.<br>NTPC is requested to confirm the same. | Bidder to refer Amended GLP being issued separately. |
| 1294. | Section VI, Part A, Sub Section III-A5 Limestone & Gypsum handling plants. | 2.01.00 | 2 of 6 | Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house.... | <u>For Meja stage-1 2×660MW:</u><br>In order to plan the tap off for limestone conveyor from the the existing coal conveyor, bidder request NTPC to provide the conveyor profile from Pent House PH-1 upto Crusher House CH. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| 1295. | Section VI, Part A, Sub Section III-A5 Limestone & Gypsum handling plants. | 2.01.00 | 2 of 6 | Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house.... | Owing to space constraints in most of the projects in Bulk Lot 1A, Bidder proposes to use the existing coal conveyor/s after the Crusher House for conveying the crushed limestone upto the extent possible or nearest area identified for limestone handling / milling building. NTPC is requested to confirm the same | Bidder shall comply with technical specification stipulations |
| 1296. | Tanda | - | - | FGD space identified in GLP | Bidder requests Owner to provide additional space for installation of limestone handling and slurry preparation system at the space / area allocated for Laydown & Pre-Assembly activies located north of O&M stores. NTPC is requested to confirm. | Bidder to refer the revised GLP in issued amendments. |
| 1297. | Tanda | - | - | FGD space identified in GLP | Bidder proposes for additional space for emergency slurry tanks between TP-13, TP-14 and west of Coal stock pile. NTPC is requested to confirm. | Bidder to refer Amended GLP being issued separately. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
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| 1298. | Tanda | - | - | FGD space identified in GLP | Bidder proposes for additional space for installation of limestone handling equipment at green belt which is between Fire station building and Hasimpur village compound wall. NTPC is requested to confirm the same. | Bidder to refer the revised GLP in issued amendments. |
| 1299. | Tanda | - | - | FGD space identified in GLP | In order to plan the tap off for limestone conveyor from the the existing coal conveyor, bidder requests NTPC to provide the conveyor profile from Pent House PH-1 upto Crusher House CH. | Noted. Detailed drawings of existing facilities shall provided to the successful bidder. |
| 1300. | Tanda | - | - | FGD space identified in GLP | For planning pipe/cable rack from ID fans upto the Space identified for FGD near H2 plant, Bidder requests Owner to provide the layout of area/facilities surrounding H2 plant along with the details of building heights of MCC rooms. | Fenced Area for H2 Building is approx. 45.0 m in N-S direction and 34.0 m in E-W direction, Building height 5.5 m.<br><br>Detailed drawing shall be provided after award of contract. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
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| 1301. | MEJA | - | - | FGD space identified in GLP | Bidder proposes to use the area identified as Space For Water Treatement Facilities Stage-II for FGD Limestone handling and slurry preparation facility. NTPC is requested to confirm the same. | The space of Water Treatement Facilities is in area identified for Stage-II which cannot be used. |
| 1302. | MEJA | - | - | FGD space identified in GLP | Bidder proposes to use the area south of AWPH & Settling and Surge tank. NTPC is requested to confirm the same. | Bidder to refer Amended GLP being issued separately. |
| 1303. | Section VI, Part A, Sub Section III-A5 Limestone & Gypsum handling plants. | 2.01.00 | 2 of 6 | Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes. | For 2×660MW Tanda:<br>Owing to the non-availability of required area & related space constraints, Bidder proposes Owner to exclude the scope / facilities pertaining to receiving limestone through railway rakes from the Scope of Bidder. Accordingly the Bidder scope may include the facilities / scope pertaining to the provision of receiving limestone only through the Trucks. Owner to confirm. | Bidder to refer the revised GLP in issued amendments. |
| 1304. | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.01.00 | 1 of 3 | The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package. | Bidder proposes to use the existing ESP pipe/cable rack near chimney area for pipe / cable routing for FGD package. | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles.<br><br>-Bidder shall comply with |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
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| | | | | | | technical specification requirement clause no: - 1.08.00.2 Sub Section- III-B, Section –VI, Part-A. |
| 1305. | Section VI / Part B / Sub Section I | General | | Lara power plant 2x800MW | Request NTPC to furnish Autocad drg no:9548-999-POM-F-001,6D0 (latest revision) | Only PDF provided. Bidder to refer the revised GLP in issued amendments. |
| 1306. | Section VI / Part B / Sub Section I | General | | Lara power plant 2x800MW | Space allocated for FGD area is currently occupied by temporary sheds (with brick walls and roofing) and Offices. Bidder requests NTPC to confirm that this identified space shall be available completely clear of any obstructions to the Bidder at the time of awarding of contract. | Bidder to refer the revised GLP in issued amendments. |
| 1307. | Section VI / Part a / Sub Section III | 2.01.00 | 2 of 6 | 2X800MW LARA-Lime stone handling plant-Lime stone will be received to power plant either through road by trucks and /or through indian railway rakes | For Lara project, three options are available for receiving limestone:-<br>a) By railway rakes<br>b) By road through trucks<br>c) By both railway rakes and road by trucks.<br>Bidder requests Owner to confirm the option that needs to be followed from those mentioned above. | Technical Specifications is clear. Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes.<br><br>Road unloading facility shall be provided for all the |

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| | | | | | | plants under this package. Wherever feasible, railway unloading shall also be provided using existing Wagon Tippler / Track Hopper as detailed out in the Technical Specifications. |
| 1308. | | | | 2X800MW LARA -<br>Pipe arrangement drawings | Bidder reuqests Owner to provide existing Pipe GAD's for all projects for<br>a) ash handling<br>b) Chimney<br>c) aux. boiler area<br>d) CHP Workshop area | Bidder to refer the revised GLP in issued amendments. |
| 1309. | Section VI / Part a / Sub Section III | 2.01.00 | 2 of 6 | 2X800MW DARLIPALI-Limestone handling plant-Lime stone will be received to power plant either through road by trucks and /or through indian railway rakes | After site visit, bidder understands that in Darlipalli there is no space for bringing limestone through indian railway rakes for storage and conveyance. Hence bidder would like to consider limestone handling only through road by trucks. please confirm. | Technical Specifications is clear. Limestone will be received to power plant either through road by trucks and/or through Indian railway rakes.<br><br>Road unloading facility shall be provided for all the |

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| | | | | | | plants under this package. Wherever feasible, railway unloading shall also be provided using existing Wagon Tippler / Track Hopper as detailed out in the Technical Specifications. |
| 1310. | Section VI / Part a / Sub Section III | 2.01.00 | 2 of 6 | 2X800MW DARLIPALI-Limestone handling plant-Lime stone will be received to power plant either through road by trucks and /or through indian railway rakes | Bidder requests Owner to provide additional land in 'SG contractors' area for the purpose of Limestone/ gypsum storage and its auxiliary system. Owner to confirm | Bidder to refer the revised GLP in issued amendments. |
| 1311. | Section VI / Part A/ Sub Section I | 1.03.06 Section 6, part-A,sub section-1 | 3 of 19 | Low height wet chimney(s) for the project | Bidder requests Owner to provide options for selection of configuration of chimney i.e. single flue or twin flue or triple flue type depending up on number of units in power plant, space availability and absorber location. Owner to confirm. | Single flue or multi flue chimney(s) can be provided by the bidder as per clause 3.14.1, Sub Section IVD, Part-B of section VI. |
| 1312. | Section VI / Part A/ Sub Section 5 | 5.01 | 8 of 26 | Chimney flue liner shall be of mild steel liner with 2mm cladding. | Bidder requests Owner to allow alternate options of providing FRP or GRP liners inplace steel liner with cladding for chimney flue. Owner to confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements under the referred cl.no. 5.01.00. |

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| 1313. | Section VI / Part A/ Sub Section 5 | 5.02.01 | 9 of 26 | WET Stack study | Bidder requests Owner to provide the list of approved technical institutes / laboratiories for carrying out Wet stack study. | Bidder to arrange for the same in compliance to tender specification requirements. |
| 1314. | Section VI / Part A/ Sub Section 5 | 5.01.00 | 9 of 26 | flue gas velocity(m/s)<18m/s at design point | As per EPRI guidelines(revised wet stack guide) the recommended velocity of flue gas is 16.8m/s for Alloy based liner. Request NTPC to confirm. | Provisions of Technical specification at cl.no. 5.01.00 are clear. Bidder shall comply with the same. |
| 1315. | BARH STPP 3x660 stage I General Layout Plan no. 9558/9560-999-POC-F-001 rev 8 | | | General Layout plan | Kindly furnish the final GLP (latest revision) in Autocad format. | Bidder to refer the revised GLP in issued amendments. |
| 1316. | BARH STPP General Layout Plan no. 9558/9560-999-POC-F-001 rev 8 | | | General Layout plan | Bidder understands that the area allocated as 'Space for FGD' in the plot plan shall be used only for Barh stage I (3 x 660) MW which is part of Lot-1A projects. Owner to confirm. | Bidder to refer Amended GLP being issued separately. |

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| 1317. | BARH | | | | Based on visit to the Site, Bidder understands that the space allocated for FGD near the coal stock area ( from 2350E 800S to 3000E 1000S) is being used by other contractors for their laydown and pre-assemeblies. Bidder requests NTPC to confirm that this identified space shall be available completely clear of any obstructions to the Bidder at the time of awarding of contract. | Bidder to refer the revised GLP in issued amendments. |
| 1318. | BARH | | | | Bidder understands from Site that few more empty spaces available. Kindly confirm the following additional space are available for FGD.<br>1) Space ear marked for Aux boiler location (750E 900S)<br>2) Space near crusher house-I on either side of curved railway track(1400E 800S) | 1) Space earmarked for aux boiler cannot be used.<br>2) Bidder to refer Amended GLP being issued separately. |
| 1319. | BARH | | | | Additional space is required for limestone/ gypsum handling systems near the FGD area. Kindly confirm that the 100m wide green belt outside the boundary wall between the Ash silo area of stage 1 and stage 2 (400E to 1000E) can be made available for FGD | Bidder to refer the revised GLP in issued amendments. |

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| 1320. | BARH | | | | Please furnish the coal crusher house G.A. drawings, G.A. of conveyer feeding to crusher house & junction tower before crusher house . This will enable us to plan for tapping towards limestone handling systems. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1321. | BARH | | | | Please furnish the G.A. of conveyer TP2 to TP3, cable trestle and pipe trestle in front of existing chimneys.This will enable us to plan for duct tapping and routing towards Absorber. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1322. | BRBCL Nabinagar TPP General Layout Plan no. 0270-999-POC-F-001 rev 7 | | | General Layout plan | Please furnish the coal crusher house G.A. drawings, G.A. of conveyer feeding to crusher house & junction tower before crusher house . This will enable us to plan for tapping towards lime handling systems. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1323. | BRBCL Nabinagar TPP 4x250 MW | | | | Please furnish the G.A. of cable trestles, Ash slurry PH and AWPH in front of existing chimneys.This will enable us to plan for duct tapping and routing towards Absorber. | Ash Slurry PH size is approximately 74.5 m in E-W direction and 25.5 m in N-S direction and height is 12.15 m from FGL.<br>AWPH Building size is approximately 37.5 m in E-W direction and 12.5 m in N-S direction and height is |

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| | | | | | | 12.5 m . AWPH building is surrounded by 5 mtr wide sump on three sides. Detailed drawing shall be provided after award.<br><br>BIdder to refer Table 6 of Sub Section- II-A 11 PROJECT INFORMATION (NABINAGAR TPP) Section –VI Part-A for Pipe/cable trestle drawings. |
| 1324. | BRBCL Nabinagar TPP 4x250 MW | | | | Kindly confirm the empty space near FGD area between coordinates 600W 1500N to 750W 1450N is available for FGD. | Bidder to refer Amended GLP being issued separately. |
| 1325. | NPGCL Nabinagar STPP stage I General Layout Plan no. 0370-999-POC-F-001 rev 9 | | | | Please furnish the coal crusher house G.A. drawings, G.A. of conveyer feeding to crusher house & junction tower before crusher house . This will enable us to plan for tapping towards lime handling systems. | Noted. Detailed drawings of existing facilities shall be provided to the successful bidder. |

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| 1326. | NPGCL Nabinagar STPP stage I | | | | In bidders's opinion, the space provided for FGD facilities in the plot plan is inadequate.<br>Additional space is required for limestone/ gypsum handling systems.<br>Kindly mark the additional space that can be provided. | Bidder to refer the revised GLP in issued amendments. |
| 1327. | NPGCL Nabinagar STPP stage I | | | | Please furnish the G.A. of cable trestles, Pipe trestles in front of existing chimneys. This will enable us to plan for duct tapping and routing towards Absorber. | Bidder to refer the revised GLP in issued amendments. |
| 1328. | NPGCL Nabinagar STPP stage I | | | | Bidder understands from Site that few more empty spaces are available. Kindly confirm the following additional space are available for FGD.<br>1) Space between ash slurry pipe corridor and conveyor 5A/5B (1500E 1500N to 1550E 1800N)<br>2) Space near crusher house-I in laydown area (1925E 1350N to 2200E 1800N)<br>3) Green Belt area adjecent to ESP, chimney and FGD area(1100E 1520N to 1390E 1550N) | 1. Bidder to refer Amended GLP being issued separately.<br><br>2. Bidder to refer Amended GLP being issued separately.<br><br>**3.** Bidder to refer the revised GLP in issued amendments. |

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| 1329. | General - All Sites | | | | Owner has not furnished any space for the Limestone and gypsum handling system. Please mark the space in the layout and clarify whether space allocated for Phase-II can be utilized for FGD and its auxiliary system. | Bidder to refer the revised GLP in issued amendments. |
| 1330. | General - All Sites | | | | Kindly provide the G.A of conveyors coming from the pent house and also G.A of crusher house building to decide the tapping point of Limestone conveying system. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| 1331. | Solapur | | | | Space allocated for booster fan is not marked in the plot plan with the clear dimensions for NPTC - Solapur project. Please mark the clear dimensions provided in front of the chimney and ESP cum VFD control room along the length and width to place booster fan with facilities. | NTPC has identified the available area for FGD. Bidder to propose his own layout(including booster fans etc.) based on site visit and in the identified available space meeting the specification requirement. |
| 1332. | Kudgi | | | | Space allocated for booster fan is not marked in the plot plan with the clear dimensions for NPTC - Kudgi project. Please mark the clear dimensions provided in front of the chimney and ESP cum VFD control room along the length and width to place booster fan with facilities. | NTPC has identified the available area for FGD. Bidder to propose his own layout(including booster fans etc.) based on site visit and in the identified available space meeting the |

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| | | | | | | specification requirement. |
| 1333. | Solapur | | | | NTPC - Solapur project -Kindly provide the G.A of conveyor 5A/5B ( from TP-4 to TP-5) for in order to route the FGD ducting ( from booster fan to Absorber) clearing the conveyor. | Conveyor Bottom Elevation is varying from RL 472.555 m at TP-4 to RL +535.1m at TP-5. Finished Ground Level is at RL +464.25m at TP-4and RL +461.3m at TP-5. Detailed drawing shall be provided after award of contract. |

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| 1334. | Section VI, Part B, Sub Section IV B | 12.00.00 | 30 of 69 | All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC:58 | NTPC Solapur & Kudgi - During site visit, it has been observed that existing roads around BTG and BOP areas are flexible pavement (bitumen road) type road. Hence Owner is requested to clarify the following points:<br>a) Wherever existing roads are of bitumen type, the connecting or approach roads to FGD facilities shall be of flexible pavement. Please confirm.<br>b) Existing bitumen road which may be damaged during construction of FGD structures, shall be restored with flexible type pavement. | (a) Bidder shall comply with technical specification requirement. (b) Noted |
| 1335. | Section VI, Part B, Sub Section IV B | 21.00.00 | 41 of 69 | RCC paving of minimum 150 mm thick with M25 grade concrete over an underbed as specified shall be provided. | Bidder understands that RCC paving within the BTG area i.e. upto the face of main peripheral road behind chimney shall be Owner's scope. Please confirm. | Extent of paving for FGD facilites shall be in accordance with Technical specification. However, any functional requirement of paving for FGD facilities not specifically mentioned in technical specification is also in the scope of bidder. |

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| 1336. | Section VI, Part A, Sub Section IIA-1 | Table 7 | 38 of 38 | Kudgi super thermal power project - General layout Plan Drawing No. 9573-999-POC-F-001, Rev. 6D1 | NTPC Kudgi - The allocated space for FGD as shown in the plot plan for locating absorber, fan, tanks etc. may not be sufficient. Hence bidder understands that the space identified for "water treatment plant of stage-II", near IDCT 1A can be utilized for locating Stage-I FGD facilities. Please confirm bidder's understanding. | The space of Water Treatement Facilities is in area identified for Stage-II which cannot be used. |
| 1337. | General - All Sites | | | | a) Bidder proposes to use existing pipe/cable rack structures for FGD pipes and cable. Please confirm.<br><br>b) Bidder requests Owner to furnish load details of the existing cable & pipe rack structure in BTG and BOP area, so that the same structure can be utilized for supporting FGD pipes and cables. | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles.<br>-Bidder shall comply with technical specification requirement clause no: - 1.08.00.2 Sub Section- III-B, Section –VI, Part-A. |
| 1338. | SECTION-VI, PART-A/SUB SECTION-III-A6/ZERO LIQUID DISCHARGE SYSTEM | 1.01.00 | 1 of 3 | Pre-treatment system consists of FGD waste water storage tank (2X50%) to store waste water. | Owner is requested to clear the discrepancy regarding quantity of FGD waste water storage tank. | The quantity/redundancy of equipment/streams/trains (working & standby) shall be followed as per "technical specification section- |

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| | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM | 3.01.00, C. | 7 of 32 | FGD waste water storage tank (2X50%) | | VI, Part-B sub section-I-M7, zero liquid discharge only. The flow diagram is only showing typical process. |
| | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3 | --- | In flow diagram only one FGD waste water collection tank is shown | | |
| 1339. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM | 3.01.00, C. | 7 of 32 | FGD waste water tanks (2X50%) shall be designed to store FGD waste water from all units of FGD system operated continuously for 24 hours and GGH washing water which is produced temporarily. | Owner to note that the capacity is calculated based on waste water from all units and average hourly flow of GGH washing water which is produced temporary or Intermittently. Owner to confirm. | This shall be decided during detailed engineering based on system requirement and specification requirements. |
| 1340. | SECTION-VI, PART-A/SUB SECTION-III-A6/ZERO LIQUID DIS- | 1.01.00 | 1 of 3 | Filter press (2X50%) | Owner is requested to clear the discrepancy regarding quantity of filter press | The quantity/redundancy of equipment/streams/trains (working & standby) shall be followed as per "tech- |

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| | CHARGE SYSTEM | | | | | nical specification section-VI, Part-B sub section-I-M7, zero liquid discharge only. The flow diagram is only showing typical process. |
| | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3 | --- | In flow diagram only one Filter press is shown | | |
| 1341. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM | 3.01.00, B., 4) | 5 of 32 | FGD wastewater tank shall be aerated by the aeration devices. | Owner to provide the details of aeration device is to be considered. We propose air scouring blowers for aeration. Owner is requested to confirm. | The aeration devices shall be as per the proven practice of OEM which shall be decided during detailed engineering. |

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| 1342. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM | 3.01.00, B., 12) | 6 of 32 | The sludge from clarifiers shall be transferred to thickeners and reuse gypsum storage tank. The overflow of thickeners shall be transferred to the FGD waste water tank/pond, and the thickened sludge shall be transferred to the filter press for sludge dewatering and reuse. | Owner to note that thickener is not shown in flow diagram where in technical requirements thickener is considered after sludge sump. Owner is requested to clarify the discrepancy. | Thickner is envisaged in the scope of the Bidder. Process flow diagram is indicative Contractor to furnish the complete scheme & P&ID during detailed engineering meeting the specification requirements. |
| | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3 | --- | No thickener | | |
| 1343. | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER | SHT-1 of 3 | --- | Clarifier water/BC feed tank/Filtrate water tank | Owner is requested to provide design basis for Clarifier water/BC feed tank. | Clarifier water/BC feed tank capacity shall residence time, at 100 % level, of no less than 30 minutes. |

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| | TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | | | | | |
| 1344. | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3 | --- | Sludge sump | Owner is requested to provide design basis for sludge sump. | This shall be decided during detailed engineering based on system requirement and specification requirements. |
| 1345. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM<br>D. PRE- | 3.01.00, D. | 7 of 32, 1) | pH adjustment, reaction and coagulation tank | Owner to note that we have considered chemical dosing system (Coagulation, polymer, Lime and Soda Ash dosing system) as shown in flow diagram. The Soda ash shall be dosed only in secondary clarifier only. Owner to confirm.<br><br>Owner is also requested to provide the | Technical specification requirement is clear. Chemical dosing sustem shall be as per proven practice of OEM which shall be decided during detailed engineering. |

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| | TREATMENT SYSTEM | | | | design basis for dosing system for sizing of lime and soda ash dosing tanks and pumps. Also the storage requirement for lime & soda ash is to be confirmed. | |
| | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3 | --- | Coagulation dosing system, polymer dosing system, Lime dosing system, Soda Ash dosing system | | |
| 1346. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM D. PRE- | 3.01.00, D., 2) | 7 of 32 | Pre-clarifier/Thickeners | We understand that the primary clarifier is HRSCC type. And Secondary clarifier is Clariflocculator type from flow diagram. Owner is requested to clarify the same. | The Clarifier type shall be as per the proven practice of OEM which shall be decided during detailed engineering. |

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| | TREATMENT SYSTEM | | | | | |
| | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3 | --- | Primary and secondary clarifier | | |
| 1347. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM D. PRE- | 3.01.00, D., 1) | 7 of 32 | pH adjustment, reaction and coagulation tank | We understand that in tender pH adjustment is denoted for lime dosing system and reaction dosing is for Soda ash dosing system. Owner is requested to confirm the same. | Technical specification requirement is clear. Chemical dosing sustem shall be as per proven practice of OEM which shall be decided during detailed engineering. |

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| | TREATMENT SYSTEM | | | | | |
| | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3 | --- | Coagulation dosing system, polymer dosing system, Lime dosing system, Soda Ash dosing system | | |
| 1348. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM D. PRE- | 3.01.00, D., 2), j) | 7 of 32 | The contractor shall design the clarifier as followings...<br>- Reaction time : 3-5 hours<br>- Surface loading : 15 - 20 m3/m2/day<br>- Efficient depth : 2-4 m<br>Linear velocity of driver : 1-2 m/min | Owner is requested to provide type of both primary and secondary clarifier. As mentioned in query number -9 if clarifier are HRSCC type then the surface loading stated in tender is lower side. Owner is requested to provide design basis for both clarifiers (lime surface loading, outlet sludge consistency etc) separately. | Technical specification requirement is clear. Clarifiers shall be as per proven practice of OEM which shall be decided during detailed engineering. |

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| | TREATMENT SYSTEM | | | | | |
| 1349. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM B. GENERAL DESIGN CRITERIA | 3.01.00, B., 15) | 6 of 32 | The softening reactor tanks and softening clarifiers shall be designed for outdoor installation | Owner is requested to confirm whether primary clarifier with sludge facility shall be considered outdoor. Kindly confirm. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |
| 1350. | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR | SHT-1 of 3 | --- | Flash mixer | Owner is requested to provide the design basis for flash mixer. | Flash mixer shall be as per the proven practice of OEM which shall be decided during detailed engineering. |

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| | ZLD (0011-109-POM-A-005) | | | | | |
| 1351. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM D. PRE-TREATMENT SYSTEM | 3.01.00, D), 2), c) | 9 of 32 | FGD softening clarifier sludge pumps | As per tender, the sludge from softening clarifier shall be transferred to sludge sump via sludge transfer pumps. We propose gravity draining of sludge from secondary/softening clarifier to sludge sump as the sludge sump is adjacent to secondary clarifier. Owner to confirm. The same case for sludge removal from primary clarifier also. | As per Technical specification, Sludge pumps shall tarnsfer sludge from Clarifier to Sludge storage sump/tank. Sludge storage sump/tank is part of FGDWWT system. As such, Sludge pumps for sludge transfer shall be decided by the Bidder based on its offered Sludge sump or Sludge Tank. |
| 1352. | SECTION-VI, PART-A/SUB SECTION-III-A6/ZERO LIQUID DISCHARGE SYSTEM | 1.01.00 | 1 of 3 | Filter press (2X50%) | Owner to provide the design basis for filter press. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |

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| 1353. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM D. PRE-TREATMENT SYSTEM | 3.01.00, D), 1), a) | 7 of 32 | pH adjustment, reaction and coagulation tank shall be square or rectangular type and installed on the concrete foundation. Tanks shall be equipped partition for smooth mixing of chemicals. Tanks shall be lined with min. 4.8 mm of rubber or equivalent material. | Owner to confirm the material of construction of dosing tanks like lime, Soda Ash. We propose RCC construction with suitable lining. For poly & liquefied PAC dosing non metallic circular tanks are suitable. Owner to confirm. | This shall be decided during detailed engineering as per proven practice of OEM. |
| 1354. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM D. PRE-TREATMENT SYSTEM | 3.01.00, D), 1), a) | 7 of 32 | Chemical dosing systems | The chemical house for zero liquid discharge system shall be two storey. The storage of chemicals shall be provided at ground floor and all dosing tanks and dosing pumps shall be located at first floor. Owner is requested to confirm. | This shall be decided during detailed engineering based on system requirement and specification requirements. |

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| 1355. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM E. EVAPORATIVE CONCENTRATION | 3.01.00, E) | 9 of 32 | Evaporative concentration | Owner is requested to provide technical datasheet for evaporative concentration (Falling film evaporator) and brine concentrator (crystallizer) along with its design basis. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |
| 1356. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM F. CENTRIFUGE | 3.01.00, F) | 10 of 32 | Centrifuge | Owner is requested to provide the type of centrifuge to be considered. Usually solid bowl type centrifuge is used. Kindly confirm. | This shall be decided during detailed engineering as per proven practice of OEM. |
| 1357. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYS- | 3.01.00, F) | 10 of 32 | Centrifuge | Owner is requested to provide design basis and material of construction for centrifuge. Also, please provide design basis for centrate tank. | This shall be decided during detailed engineering as per proven practice of OEM. |

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| | TEM<br>F. CENTRIFUGE | | | | | |
| 1358. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM<br>F. CENTRIFUGE | 3.01.00, F), 3), 4) | 10 of 32 | 3) Sludge filter press shall be manually and automatically operated.<br>4) All accessories of centrifuge, filter press shall be provided by the contractor. | As per our understanding, only centrifuge is required as dewatering unit after crystallizer.<br>The filter press is used for dewatering of sludge drained from primary and secondary clarifier.<br>Owner is requested to confirm the understanding. | Confirmed. |
| 1359. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM<br>F. CENTRIFUGE | 3.01.00, F), 3), 4) | 10 of 32 | --- | Owner is requested to clarify whether sludge building is to be considered for centrifuge and filter press (for primary and secondary sludge handling system. | This shall be decided during detailed engineering as per proven practice of OEM. |

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| 1360. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM G. CHEMICAL FEED EQUIPMENT | 3.01.00, G), 2) | 11 of 32 | The contractor shall design chemical tanks as followings<br>a) Chemical storage tanks : 15 days<br>b) Chemical dissolving tank : 3 days<br>c) Chemical dosing/injection tank : 24 hours | Owner to note that the chemical storage tanks is applicable for PAC and poly (liquid) only. We shall consider 15 days storage for solid chemical like soda ash and lime.<br>Also, we propose that the dissolving tanks are not necessary to be considered. We may directly prepare solution in chemical dosing/injection tanks. Owner is requested to confirm. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |
| 1361. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM H. WASTE WATER TANK | 3.01.00, H) | 15 of 32 | Waste water tank | Owner is requested to provide design basis of waste water tank like retention time for waste water tank and design basis for pump like hours to emptied out waste water tank. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |

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| 1362. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM | 3.02.05, 3. | 23 of 32 | The FFE shall be designed for outdoor service with the accessory equipment located indoors. | We understand that except evaporator, all equipment involved in evaporation process like evaporator feed tank, heat exchanger, deaerator, compressor, evaporator seed tank with pump, recirculation pump etc shall be located inside the building. Owner to confirm. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |
| 1363. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM | 3.02.06 | 28 of 32 | Crystallizer, crystallizer feed tank, crystallizer brine tank & crystallizer heat exchanger equipment | Bidder requests Owner to provide the retention time for crystallizer feed tank, caustic feed tank, crystallizer distillate tank. | This shall be decided during detailed engineering as per proven practice of OEM. |
| 1364. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM | 3.02.06 | 28 of 32 | Crystallizer, crystallizer feed tank, crystallizer brine tank & crystallizer heat exchanger equipment | Owner is requested to clarify the location of crystallizer with all related equipments/tanks shall be indoor (in building) or outdoor or in shed. | This shall be decided during detailed engineering as per proven practice of OEM. |

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| 1365. | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-2 of 3<br>SHT-3 of 3 | --- | Antifoam, Antiscalant and anhydrous calcium sulfate | There is no details are available for antifoam, antiscalant and anhydrous calcium sulfate dosing system for Evaporator/crystallizer. Owner is requested to provide the same. | Technical specification requirement is clear. However antifoam, antiscalant and anhydrous calcium sulfate dosing system for Evaporator/crystallizer shall be as per proven practice of OEM which shall be decided during detailed engineering. |
| 1366. | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3<br>SHT-2 of 3<br>SHT-3 of 3 | --- | The quantity of equipment/streams shown | We understand that the quantity/redundancy of equipment/streams/trains (working & standby) shall be followed as per "technical specification section-VI, Part-B sub section-I-M7, zero liquid discharge only. The flow diagram is only showing typical process. Owner is requested to confirm. | Confirmed. |

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| 1367. | PROCESS FLOW DIAGRAM FOR FGD WASTE WATER TREATMENT SYSTEM FOR ZLD (0011-109-POM-A-005) | SHT-1 of 3<br>SHT-2 of 3<br>SHT-3 of 3 | --- | --- | Owner is requested to provide P&I diagram of FGD waste water treatment system for ZLD for mopunjre clarity. | Process flow diagram is indicative Contractor to furnish the complete scheme & P&ID during detailed engineering meeting the specification requirements. |
| 1368. | SECTION-VI, PART-B/SUB SECTION-I-M7/ZERO LIQUID DISCHARGE SYSTEM | --- | --- | --- | Owner is requested to provide technical datasheet for FGD waste water treatment system for ZLD for more clarity. | Bidder query is not clear. Bidder shall comply technical specification requirement. |
| 1369. | BARH-I-II-A10 BARH STPP-I GENERAL LAYOUT PLAN - 9558/9560-999-POC-F-001, 8-D0 | --- | 32 of 35 | Space for FGD | The location/space is not shown/identified for FGD WWT-ZLD in provided plot plan. Owner is requested to confirm/ identify the same. | Specification requirement is clear. |

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| 1370. | MOUDA STPP General Layout Plan no. 9561-999-POC-F-001 | | | | Bidder understands that the area marked as 'Space for FGD' in the plot plan shall be used only for Mouda 2 x 660 MW which is part of Lot-1A projects. | Bidder to refer Amended GLP being issued separately. |
| 1371. | Section VI, Part A, Sub Section III-A1 FGD | 25.00.01 | 9 of 9 | Wet stack of 150 metre height shall be provided with a stack condensate collection system to avoid the carryover of the condensate/acidic dews/water droplets/Gypsum coming out of the stack. Design of the wet stack condensate system should be such that all the condensate are collected in the stack itself and no water droplet/condensate come out of the chimney and preventing falling of the acidic dews/water droplet/gypsum from the chimney in the plant/nearby area | All of the acidic dew / water droplets which is collected in the stack shall be directly drained to the absorber. No additional condesate collection system shall be provided. NTPC is requested to confirm Bidder's proposal. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1372. | Site Visit: BARH 3x660MW (Stage-1), Nabinagar 3x660MW | - | - | Information as collected during site visit | Bidder understands that for all these three plants, three Station Switchgears (with two bus section in each switchgear) is available in Purchaser's Power House Building & Bidder can consider AHP Feeder from any two switchgears to feed | Refer amended Tender SLD. |

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| | (NPGCL), Kudgi 3x800MW Stage-I | | | | FGD 11KV Switchgear. | |
| | Electrical Single Line Diagram, Dwg. No. 0011-109-POE-J-001/A-E, Rev. A | - | - | One Common 11KV Switchgear with 2 Incomer & 1 Buscoupler indicated in Key SLD which is applicable all facilities (except Booster Fan motor) of FGDs for all 3 units | | |
| 1373. | Site Visit: All plants except Nabinagar (4x250MW & 3x660MW) Plants | - | - | Information as collected during site visit | Bidder understands that for all the plants except Nabinagar (4x250MW & 3x660MW) plants, one no. Spare Motor Feeder & One Spare Transformer feeder is available in Existing 11KV Station Switchgear of each Unit and these spare | Refer amended Tender SLD & Scope.Bidder's understanding regarding modification in Employer's station swgr Incomer & Busbar is correct. |

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| | Electrical Single Line Diagram, Dwg. No. 0011-109-POE-J-001/A-E, Rev. A | - | - | Note No. 10: Two Nos. 11 KV Motors per unit can be fed from existing spare feeders in Station Switch Boards. Necessary Augmentation & Modification required in Switchgear Panels for this purpose shall be in scope of Bidder. | feeders will be suitably modified/augmented to suit the requirement of Bidder's 11KV Booster Fan Motors. However Bidder has not envisaged any modification/ upgradation of Purchaser's Incomers & Main Horizontal Busbar of 11KV Station Switchgear as we do not have loading details of Purchaser's 11KV Station Switchgear. | |
| 1374. | Site Visit: BARH 3x660MW (Stage-1), Nabinagar 3x660MW (NPGCL), Kudgi 3x800MW Stage-I | - | - | Information as collected during site visit | Bidder understands that for all these three plants, Separate feeders are available for CHP & AHP HT Transformer in Purchaser's 11KV station Switchgear and Bidder envisages to modify AHP HT Transformer Feeders (NOT CHP Feeders) to feed Bidders 11KV FGD tie Switchgear. Purchaser to confirm/clarify. | Refer amended Tender SLD. |

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| | Electrical Single Line Diagram, Dwg. No. 0011-109-POE-J-001/A-E, Rev. A | - | - | Note 11: Panel being used for feeding of CHP/AHP HT transformer shall be suitably modified to DD type for feeding of 11kV FGD tie switchgear CHP/AHP HT transformer shall then inturn be fed from 11 kV Tie switchgear. Necessary cabling upto AHP/CHP transformers shall also be in scope of bidder. | | |
| 1375. | Site Visit: Nabinagar 4x250MW Plant | - | - | Information as collected during site visit | As per site data for Nabinagar 4x250MW Plant, there are two nos. of 6.6KV Station Switchgears (with two bus section in each switchgear) for all four Units, with each switchgear having 4 nos. spare feeders (2 motor feeders & 2 transformer feeders). Bidder understands that Booster fan motors for this project will be 6.6KV & all these spare feeders can be used by Bidder. Spare feeders will be suitably modified/augmented to suit the requirement of Bidder's 6.6KV Booster Fan motors. However Bidder has not envisaged any modification/ upgradation of Purchaser's Incomers & Main Horizontal Busbar of 6.6KV Station Switchgear. | Refer amended Tender SLD. |
| | Electrical Single Line Diagram, Dwg. No. 0011-109-POE-J-001/A-E, Rev. A | - | - | Note No. 10: Two Nos. 11 KV Motors per unit can be fed from existing spare feeders in Station Switch Boards. Necessary Augmentation & Modification required in Switchgear Panels for this purpose shall be in scope of Bidder. | | |

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| 1376. | Site Visit: Nabinagar 4x250MW Plant | | | Information as collected during site visit | Bidder understands that for Nabinagar 4x250MW Plant, Separate 6.6KV feeders available for CHP & AHP HT Transformer in Purchaser's 6.6KV station Switchgear and Bidder envisaged to modify AHP Transformer Feeders (NOT CHP Feeders) to feed Bidders 6.6KV FGD tie Switchgear. Purchaser to confirm/clarify. | Refer amended Tender SLD. |
| | Electrical Single Line Diagram, Dwg. No. 0011-109-POE-J-001/A-E, Rev. A | | | Note 11: Panel being used for feeding of CHP/AHP HT transformer shall be suitably modified to DD type for feeding of 11kV FGD tie switchgear CHP/AHP HT transformer shall then inturn be fed from 11 kV Tie switchgear. Necessary cabling upto AHP/CHP transformers shall also be in scope of bidder. | | |
| 1377. | Site Visit: Nabinagar 4x250MW Plant | | | Information as collected during site visit | It is observed that BRBCL plant has 2 Central Control rooms, i.e. CCR-1 for Unit-1 & 2 and CCR-2 for Unit-3 & 4.<br>Bidder understands that FGD OWS to be located in Central Control room, shall be placed in CCR-1, in case of BRBCL plant. Kindly confirm. | Bidder's understanding is not correct.<br>Bidder to refer clause 9.02.00, PART-A Sub Section-IIIC, wherein it is mentioned that Control, operation and monitoring of FGD and associated system being provided under the contract is primarily envisaged from Contractor's OWS placed in FGD control room. In addition to above, |
| | Section-VI PART-E, Tender drawing no. 0000-151-POI-A-013 | - | - | FGD PLC OWS in Central Control Room | | |

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| | | | | | | it is also envisaged to control, operate and monitor FGD and associated system remotely from main plant Central Control Room (CCR). It is further clarified that to achieve the above, FGD OWS shall be located in respective unit section of CCR. For example, in BRBCL project, CCR-1 (for Unit-1 & 2) shall have 04 nos. of FGD OWS - 02 nos. for Unit-1 and 02 nos. for Unit-2. Refer amended tender drawing 0000-151-POI-A-013 in this regard. |
| 1378. | Site Visit: Nabinagar 3 X 660 MW (NPGCL), Kudgi 3x800MW Stage-I | | | Information as collected during site visit | It is observed that these plants (Nabinagar 3 X 660 MW (NPGCL), Kudgi 3x800MW Stage-I) have 2 Central Control rooms, i.e. CCR-1 for Unit-1 and CCR-2 for Unit-2 & 3.<br>Bidder understands that FGD OWS to be | Bidder's understanding is not correct.<br>Bidder to refer clause 9.02.00, PART-A Sub Section-IIIC, wherein it is mentioned that Control, opera- |

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| | Section-VI PART-E, Tender drawing no. 0000-151-POI-A-013 | - | - | FGD PLC OWS in Central Control Room | located in Central Control room, shall be placed in CCR-1, in case of these plants. Kindly confirm. | tion and monitoring of FGD and associated system being provided under the contract is primarily envisaged from Contractor's OWS placed in FGD control room. In addition to above, it is also envisaged to control, operate and monitor FGD and associated system remotely from main plant Central Control Room (CCR). It is further clarified that to achieve the above, FGD OWS shall be located in respective unit section of CCR. For example, in BRBCL project, CCR-1 (for Unit-1 & 2) shall have 04 nos. of FGD OWS - 02 nos. for Unit-1 and 02 nos. for Unit-2. Refer amended tender drawing 0000-151-POI-A-013 in this regard. |

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| 1379. | Section-VI PART-A, Sub-Section-III-C (C&I) | 9.01.00 | 7 of 8 | ... Contractor shall provide Remote Input Output (RIO) for PLC per unit, placed in Central Equipment Room (CER) for the same... | Bidder understands that UPS and non-UPS power feeders as required for Bidder's FGD OWS to be mounted in Central Control room and FGD PLC Remote I/O Panels to be located in Central Equipment rooms, shall be provided by Purchaser. Kindly confirm. | It is clarified that NTPC shall provide 02 nos. of UPS power feeder per unit from employer's ACDB, for powering FGD OWS located in CCR. Cabling from ACDB to FGD OWS (located in CCR) shall be in bidder's scope of supply.<br><br>Bidder to refer clause 9.01.00, PART-A Sub Section-IIIC, wherein it is mentioned that NTPC shall provide 2 (Two) nos. of 24V DC power supply feeders per unit from employer's DCDB, for powering RIO panel located in CER. Cabling from DCDB to RIO panel (located in CER) shall be in bidder's scope of supply. |
| | Section-VI PART-E, Tender drawing no. 0000-151-POI-A-013 | - | - | FGD PLC OWS in Central Control Room | | |

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| 1380. | Section-VI PART-A, Sub-Section-III-C (C&I) | 9.01.00 | 8 of 8 | ... contractor to consider IOs ... for minimum number of hardwired signal exchange per unit as follows DI - 80, DO - 80, AI - 20 and AO- 20. | Bidder understands that necessary provision in FGD PLC, for hardwired interface between DCS and FGD PLC shall be in Bidder's scope. However, I/O channels, marshalling TBs etc. as required at Purchaser's DCS for the same shall be in Purchaser's scope.<br>Kindly confirm. | Bidder's understanding is correct. |
| 1381. | Section-VI PART-E, Tender drawing no. 0011-109-POE-J-001A/E | - | - | Power feeders for FGD Booster fans | Bidder understands that Power feeder cables for FGD Booster fans can be laid in Purchaser's cable trays (following cable route of ID fans from HT Switchgear room), and no additional trestle/trays are required for the same, till the ID fan location.<br>Kindly confirm. | Refer amended tender SLD.<br>-Bidder shall comply with technical specification requirement clause no: -1.08.00.2.However bidder may visit the project in order to get itself acquainted with existing electrical of plant. GLP of respective plants has already been attached. |

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| 1382. | Section-VI PART-E, Tender drawing no. 0011-109-POE-J-001A/E | - | - | Power feeder for FGD HT Switchgear | Bidder understands that Power feeder cables for FGD HT Switchgear can be laid in Purchaser's cable trays (following cable route of AHP/CHP systems from HT Switchgear room), and no additional trestle/trays are required for the same, till the AHP/CHP Switchgear rooms.<br>Kindly confirm. | Refer amended tender SLD.<br>-Bidder shall comply with technical specification requirement clause no: -1.08.00.2.However bidder may visit the project in order to get itself acquainted with existing electrical of plant. GLP of respective plants has already been attached. |
| 1383. | Section-VI PART-E, Tender drawing no. 0011-109-POE-J-001A/E | - | - | Power feeders from FGD HT Switchgear to AHP/CHP HT Switchgears | Bidder understands that CHP/AHP HT Power feeder cables to be fed from FGD HT Switchgear can be laid in existing cable trays routed to CHP/AHP switchgear rooms.<br>Only interconnecting cable trestles/trays as required, to connect the present cable trestle route with Bidder's FGD switchgear room shall be in Bidder's scope.<br>Kindly confirm. | Refer amended tender SLD.<br>-Bidder shall comply with technical specification requirement clause no: -1.08.00.2.However bidder may visit the project in order to get itself acquainted with existing electrical of plant. GLP of respective plants has already been attached. |

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| 1384. | Site Visit: Tanda 2x660MW Plant (Stage-II) | - | - | | Bidder requests Owner to provide below information for Tanda Project:<br><br>1) No of station transformers/ 11 kv station switchgear<br>2) Existing 11 KV station switchgear SLD from which FGD 11 kV switchgear & booster fan shall be supplied.<br>3) CCR and CER layout to judge the space availability for FGD R I/O panels, Interface with main Plant DDCIMS, Space for OWS. | 1&2.Refer amended Tender SLD & Scope.<br>**3. Space allocation in CER and CCR for RIO and FGD OWS respectively shall be discussed and decided during detailed engineering.** |
| | Tender SLD-electrical single line diagram for FGD package | General notes-10 & 11 | - | Note 10: Two numbers 11 kV Motors per unit can be fed from existing spare feeders in station boards. Necessary Augmentation and modification required in switchgear panels for this purpose shall be in scope of Bidder.<br><br>Note 11: Panel being used for feeding of CHP/AHP HT transformer shall be suitably modified to DD type for feeding of 11kV FGD tie switchgear CHP/AHP HT transformer shall then inturn be fed from 11 kV Tie switchgear. Necessary cabling upto AHP/CHP transformers shall also be in scope of bidder. | | |
| | Section-VI PART-A, Sub-Section-III-C (C&I) | 9.01.00 | 8 of 8 | Hardwired Signal exchange:... Contractor shall provide Remote Input Output (RIO) for PLC per unit, placed in Central Equipment Room (CER) for the same. | | |

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|---|---|---|---|---|---|---|
| 1385. | Site Visit: Nabinagar 3x660MW (NPGCL) | - | - | Information as collected during site visit | As informed by NTPC site team, only one no. of spare feeder is available in each 11KV Station Switchgear (i.e. one no. spare motor feeder available in SA bus, no spare feeder available in SB bus). NTPC to please advise. | Bidder to refer amended electrical scope for information on feeders identified for use of FGD. |
| | Electrical Single Line Diagram, Dwg. No. 0011-109-POE-J-001/A-E, Rev. A | - | - | Note No. 10: Two Nos. 11 KV Motors per unit can be fed from existing spare feeders in Station Switch Boards. Necessary Augmentation & Modification required in Switchgear Panels for this purpose shall be in scope of Bidder. | | |
| 1386. | SECTION – VI, PART-E / TENDER DRAWING LIST | 0011-109-POM-A-002 | | | Bidder considers quantity of limestone slurry pump as following:<br>1. 4 nos of pumps for 2 units<br>2. 6 nos of pumps for 3 units<br>3. 8 nos of pumps for 4 units<br>Please confirm. | Bidders understanding is correct. |
| 1387. | SECTION – VI, PART-E / TENDER DRAWING LIST | 0011-109-POM-A-002 | | Limestone grinding area sump | Bidder considers only Limestone grinding area sump shown in "0011-109-POM-A-002". Please confirm. | Bidder's understanding is correct. |

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| | | 0011-109-POM-A-003 | | Limestone grinding area sump | | |
| 1388. | TECHNICAL SPECIFICATION SECTION.YI, PART·A/ SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES | 4.02.00 | 18 of 24 | The Contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10m3/hr averaged over a 24 hour period from each unit. | Waste water Purge flow rate of 10m3/hr seems to be low. Actual quantity of purge flow rate shall depend on HCl content in flue gas and Cl content in process water of corresponding project. Please confirm. | Bidder shall design its system meeting the waste water treatment system purge flow rate specified. |
| 1389. | TECHNICAL SPECIFICATION SECTION-VI, PART·A SUB·SECTION· V SALAIENT DESIGN DATA & SIZING | 6.00.00 note-1 | 10 of 26 | Guaranteed parameters (guarantee on limestone consumption, auxiliary power consumption & gypsum purity) shall be based on available (reactive) CaC03 content of 89%. The design of Flue Gas Desulphurisation (FGD) system & auxiliaries shall be based on available (reactive) CaC03 content of 79%. | Bidder will design the FGD system considering CaO as 51% for guarantee point and CaO as 47% for design point. Please confirm. | Specification requirements are quite clear in the referred clauses. Bidder shall comply with the specification requirements. |

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| | | | | | | |
| | TECHNICAL SPECIFICATION SECTION-VI, PART·A SUB·SECTION· V SALAIENT DESIGN DATA & SIZING | 6.00.00 | 10 of 26 | LIMESTONE CHARACATERSTICS:<br>CaO: 47-51% | | |
| 1390. | SECTION – VI, PART-A / SUB-SECTION-II-A10 Project Information DARLIPALI (2X800 MW) | | 28 of 30 | TABLE-4<br>Design clarified water analysis | Please provide the amount of suspended solid present in clarified water. | As mentioned in Design Clarified water analysis, Turbidity shall not be more than 10 NTU. |

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|---|---|---|---|---|---|---|
| 1391. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 6.05.01 | 22 of 51 | iv) Output Fineness<br>Output Fineness 90% or higher (as per the requirement of the absorber) through 325 mesh (for spray tower process) OR 90% or higher (as per the requirement of the absorber) through 200 mesh (for bubbling process) | Bidder understands that for Jet Bubbling process absorber, guarantee of 90% or higher (as per the requirement of the absorber) through 200 mesh (for bubbling process) shall be applicable in line with Technical Specifications. Kindly confirm. | Bidder to refer necessary amendment in this regard. |
| | TECHNICAL SPECIFICATION SECTION.YI, PART·A/ SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES | 4.02.00 | 17 of 24 | 90% or higher (as per the requirement of the absorber) through 325 mesh. | | |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| 1. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 3.01.00 | 5 of 51 | The entire flue gas system, flue gas ducts, absorber etc. shall be designed to meet the following conditions:<br>Design internal pressure at 67% +660 and -150 mmwc or maximum yield strength (mm wc):<br>+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher | Bidder shall consider the design pressure as +660 and -150 mmwc. Kindly confirm. | Bidder to refer necessary amendment in this regard. |
| | | 16.01.03 | 39 of 51 | Duct Design Pressure:<br>All flue gas ducts shall also be designed for ± 660 mm w.g., or maximum conceivable pressure of the relevant fans, whichever is higher at 67% of yield strength of material | | |
| 2. | SECTION – VI, PART-A / SUB-SECTION-II-A10 Project Information | | 28 of 30 | TABLE-4<br>COC: 5-5.5 | Bidder shall consider the COC as 5 for all project except "MOUDA" project where COC is considered as 4. Please confirm. | Confirmed. |

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|---|---|---|---|---|---|---|
| 3. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 7.07.10 | 29 of 51 | Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level. The Bucket conveyors shall be sized to completely feed each lime silo within 2hrs. | Bidder understand the bucket conveyor quantity shall be (1Working+1Standby). Please confirm. | Bidder to refer subsection III-A5 of Section VI part A for offering the feeding system to Limestone day silo |
| 4. | SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD) | 6.05.01 | 22 of 51 | Each mill shall be sized to meet 110% of the maximum limestone requirement of all the units in a project…. | Bidder understands each mill shall be sized to meet 110% of the maximum limestone requirement of all the units in a project. | Bidder's understanding is correct. |
| | | 6.05.01-ii | 22 of 51 | Flow: 110% of limestone requirement of two absorbers at Design point | | |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| 5. | 2x800MW GADARWARA TPP | - | - | FGD space identified in GLP | NTPC has identified two areas next to ID fan/Chimney. In bidder's opinioin same is not sufficient for accomodation of FGD facilities.<br>Based on site visit by BIDDER on 10.08.2017, additional areas were identified.<br>1) 70m x 120m north of IDCT 1 and East of WTP area.<br>2) 35m x 260m north of WTP area in the green belt<br>3) 30m x 115m north of TP-1 (17565.15N 16781.19E)<br>4) 45m x 45m sounth of MCC-1A CONV.1B<br>5) 50 x 50m south of CONV. 4B<br>6) 50M X 50M South of HTSWGR+MCC -1B & CHP Control Room.<br>7) 3 area each 50m x 50m north of coal stock yard south of conv. 12 B<br>8) 80m x 45m and 45m x 45m south of raw water reservoir and West of MCC-1C. | Bidder to refer the revised GLP in issued amendments. |

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| | | | | | Kindly confirm the same. | |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.01.00 | 1 of 3 | The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package. | For Gadarwara:<br>As per tender terminal point information, all other utility pipe lines (Except process water) shall be tapped off along C row near CD bay rack. Bidder proposes to use client's pipe/cable rack for routing FGD Scope pipes/cables or else these tap offs shall be taken from client's pipe rack which is nearer to proposed FGD package. NTPC is requested to confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| | 2x800MW GADARWARA TPP | | | FGD space identified in GLP | The area identified by NTPC on either sides of chimney is 25m x 116m. However after site visit, bidder understands availability of 50m x 116m space at the same place. Kindly confirm. | Bidder to refer Amended GLP being issued separately. |
| | 2x800MW GADARWARA TPP | | | | Please provide the latest copy of GLP as bidder observed some additional cable racks running from the C-D bay and parallel to boiler mill, supported on mill columns through cantilevers. | Bidder to refer the revised GLP in issued amendments. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | 2x800MW GADARWARA TPP | - | - | FGD space identified in GLP | The identified area is the GLP is not sufficient for the FGD facilities, hence Bidder request NTPC to confirm whether the spaces identified under Laydown area, Temporary storage area for BTG contractors can be used for FGD facilities. | Bidder to refer the revised GLP in issued amendments. |
| | 2x800MW GADARWARA TPP | - | - | FGD space identified in GLP | At the identified location for FGD facilites in GLP, NTPC is requested to provide the area free from any temporary structure (super structure and foundation) and the Land to be graded upto FGL. Kindly confirm. | Bidder to refer the revised GLP in issued amendments. |
| | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.08.00 | 2 of 3 | FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank, and 300 mm above FFL in HCSD Silo Area. | For Gadarwara:<br>For terminating the waste water pipes near HCSD mixing tanks, bidder proposes to use the existing pipe rack available for routing and supporting the pipes. NTPC is requested to confirm the same. | Bidder to refer the revised GLP in issued amendments. |

# CLARIFICATION No.01 (TECHNICAL)
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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | Section VI, Part A, Sub Section III-A5 Limestone & Gypsum handling plants. | 2.01.00 | 2 of 6 | Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house.... | For Gadarwara:<br>In order to plan the tap off for limestone conveyor from the the existing coal conveyor, bidder request NTPC to provide the conveyor profile from Pent House PH-1 upto Crusher House CH. | Bidder to refer the revised GLP in issued amendments. |
| | Section VI, Part A, Sub Section III-A5 Limestone & Gypsum handling plants. | 2.01.00 | 2 of 6 | Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house.... | For Gadarwara:<br>Owing to space constraints in most of the projects in Bulk Lot 1A, Bidder proposes to use the existing coal conveyor/s after the Crusher House for conveying the crushed limestone upto the extent possible or nearest area identified for limestone handling / milling building. NTPC is requested to confirm the same | Bidder to refer the revised GLP in issued amendments. |
| | 2x800MW GADARWARA TPP | | | | The pipe rack indicated on the southern side of the chimney in the GLP is not available at site. Kindly let us know whether the same will be constructed at a later stage. | Bidder to refer the revised GLP in issued amendments. |

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|---|---|---|---|---|---|---|
| | 2x800MW GADARWARA TPP | | | | Bidder understands from the site visit that important/heavy structures are on piles and other lightly loaded and miscellaneous structures are on isolated/raft footing.<br>In view of the same, kindly let us know the foundation preference for the following structures whether its on pile or isolated/raft.<br>1) Main Absorber<br>2) Booster fan<br>3) Duct supporting trestle<br>4) Pipe racks<br>5) Lime crusher building<br>6) Lime storage hoppers and silos<br>7) Wet ball mill<br>8) Wet ball mill buildings<br>9) Lime slurry tanks<br>10) Process water tanks<br>11) Gypsum de-watering building<br>12) FGD control room/ MCC building<br>13) Conveyor trestles if provided | Bidder to refer the revised GLP in issued amendments. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | 2x660 MW MOUDA STAGE - II | - | - | FGD space identified in GLP | NTPC has identified two areas next to ID fan/Chimney. In bidder's opinioin same is not sufficient for accomodation of FGD facilities.<br>Based on site visit by BIDDER on 09.08.2017, additional areas were identified.<br>1) 180m x 160m north-east of O&M stores. This appears to be fenced and permission is requested from NTPC for usage.<br>2) Triangular area 96m x 104m on the north-wast of existing fly ash silos.<br>3) Traingular area 250m x 220m South-west of existing fly ash silo<br>4) 75m x 75m north of TP16 and south-west of storage shed for unit assemblies.<br>5) 100m x 60m west immediately west of Crusher house2 and north of HT switchgear and CHP control room.<br>6) Complete space for laydown and pre-assembly for stage-II immediately east of Stock pile 6. | Bidder to refer Amended GLP being issued separately. |

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|---|---|---|---|---|---|---|
| | | | | | Kindly confirm the same. | |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.01.00 | 1 of 3 | The terminal points identified herein below shall be read in conjunction with the tender drawings, scope of supply and technical specifications of various systems covered under the package. | MOUDA STAGE - II:<br>As per tender terminal point information, all other utility pipe lines (Except process water) shall be tapped off along C row near CD bay rack. Bidder proposes to use client's pipe/cable rack for routing FGD Scope pipes/cables or else these tap offs shall be taken from client's pipe rack which is nearer to proposed FGD package. NTPC is requested to confirm. | Bidder to refer the revised GLP in issued amendments. |
| | 2x660 MW MOUDA STAGE - II | | | FGD space identified in GLP | The bidder requests NTPC to provide the area immediately east of CT4A for construction laydown of FGD facilities. | Bidder to refer the revised GLP in issued amendments. |
| | 2x660 MW MOUDA STAGE - II | | | FGD space identified in GLP | Bidder would like to utilise the green belt area immediately outside the boundary of the plant north of space for laydown and way south of Village kumbhari. Kindly confirm. | Bidder to refer the revised GLP in issued amendments. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | 2x660 MW MOUDA STAGE - II | - | - | FGD space identified in GLP | The identified area is the GLP is not sufficient for the FGD facilities, hence Bidder request NTPC to confirm whether the spaces identified under Laydown area, Temporary storage area for BTG contractors can be used for FGD facilities. | Bidder to refer the revised GLP in issued amendments. |
| | 2x660 MW MOUDA STAGE - II | - | - | FGD space identified in GLP | At the identified location for FGD facilites in GLP, NTPC is requested to provide the area free from any temporary structure (super structure and foundation) and the Land to be graded upto FGL. Kindly confirm. | Bidder to refer the revised GLP in issued amendments. |
| | Section VI, Part A, Sub Section IV Terminal Points & Exclusions | 1.08.00 | 2 of 3 | FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank , and 300 mm above FFL in HCSD Silo Area. | MOUDA STAGE - II:<br>For terminating the waste water pipes near HCSD mixing tanks, bidder proposes to use the existing pipe rack available for routing and supporting the pipes. NTPC is requested to confirm the same. | Bidder to refer the revised GLP in issued amendments. |

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| Sr. No. | Section / Part / Chapter / Volume | Clause No. | Page No. | Bid specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | Section VI, Part A, Sub Section III-A5 Limestone & Gypsum handling plants. | 2.01.00 | 2 of 6 | For Meja stage-1 2×660MW: Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house.... | MOUDA STAGE - II<br>In order to plan the tap off for limestone conveyor from the the existing coal conveyor, bidder request NTPC to provide the conveyor profile from Pent House PH-1 upto Crusher House CH. | Noted. Detailed drawings of existing facilities shall provided with the successful bidder. |
| | Section VI, Part A, Sub Section III-A5 Limestone & Gypsum handling plants. | 2.01.00 | 2 of 6 | Limestone received through Indian Railway Rakes will be unloaded in one of the side discharge Wagon Tipplers or Track Hopper of existing Coal Handling Plant (CHP). Before existing Crusher house of CHP, the unloaded limestone will be fed to new limestone crusher house.... | MOUDA STAGE - II:<br>Owing to space constraints in most of the projects in Bulk Lot 1A, Bidder proposes to use the existing coal conveyor/s after the Crusher House for conveying the crushed limestone upto the extent possible or nearest area identified for limestone handling / milling building. NTPC is requested to confirm the same | Bidder shall comply with technical specification stipulations |

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| Sl. No. | Volume / Section | Cl. No. | Bid Specification Stipulation | Bidder's query/Stipulation | NTPC Clarifications |
|---|---|---|---|---|---|
| | MECHANICAL SYSTEMS | | | | |
| 1416 | Section VI, Part A, Sub-Section - IV, Terminal Points & Exclusions | 1.09.00 Lime Stone. 1.10.00 Gypsum | i) For Lime Stone unloading WT/Track Hopper of the existing CHP……. Ii) For unloading with Road truck unloading system, entry to truck unloading area. | Kindly Furnish Flow Diagram / Layout drawing for limestone unloading, handling and Gypsum storage systems as the same is not attached with tenders drawings. | Bidder may come with proposal based on plant layout available in tender drawings and site visit. NTPC reserves the right to freeze a basic layout for each NTPC plant post techno commercial bid discussions. |
| | Section VI, Part A, Sub-Section - IV, Terminal Points & Exclusions | 1.10.00 Gypsum | outlet of Gypsum storage silo/shed | | |
| | Section VI, Part A, Sub-Section - II, - A1 to A11, Project Information | Tender Drawings | Tender Drawings - Main plant Layouts | In Main Plant layouts, only space for FGD is marked, bidder request to provide FGD system / equipment layout drawings for more clarity. | NTPC has identified the available area for FGD. Bidder to propose his own layout based on site visit and in the identified available space meeting the specification requirement. |
| | Section VI, Part E, Tender Drawings | Scheme of FGD Absorber System | Slurry piping & Pumps flushing system | We understand that slurry recirculation pump will be in operation during flushing of recirculation pipe line as capacity of process water pump is very low for full bore flow. Kindly confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| Sl. No. | Volume / Section | Cl. No. | Bid Specification Stipulation | Bidder's query/Stipulation | NTPC Clarifications |
|---|---|---|---|---|---|
| | Section VI, Part E, Tender Drawings | Scheme of FGD Absorber System | Scheme of FGD Absorber System | GGH is not considered bidder's scope as same is not indicated in the tender scheme of FGD.<br>Kindly confirm the requiremnt of GGH. | Bidders consideration is correct. |
| | Section VI, Part B, | 5.06.16 | Lining Material and technical applications requirements shall be furnished by manufacturer experienced with similar FGD plants. | Kindly clarify the requirement of alloy material for the inlet duct to the absorber.<br>Further, the extent of alloy material for inlet duct shall be decided during detail engineering by the bidder.<br>Please confirm | Bidder shall provide & select the Lining material as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements. |
| | Section-VI, Part-B, Sub-section-I-M7 - ZLD System | Cl. 3.01.00 (B) (2), Pg. 5 of 32 | "The Capacity of FGD WWT Plant for ZLD for Barh-I (3x660 MW) and Nabinagar JV (4x250 MW) shall not be less than 30 m3/hr and 20 m3/hr respectively." | The type of Clarifier is not mentioned. For this capacity, Lamella Clarifier can be considered. Please confirm. | The Clarifier type shall be as per the proven practice of OEM which shall be decided during detailed engineering. |
| | Section-VI, Part-B, Sub-section-I-M7 - ZLD System | Cl. 3.01.00 (G) (6), Pg. 11 of 32 | Coagulant shall use the liquefied PAC. | Organo-Sulphide Dosing is not mentioned,. And shall be decided after award of package, based on sub-supplier recommendation and experience. | Noted. |

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|---|---|---|---|---|---|
| | Section-VI, Part-B, Sub-section-I-M7 - ZLD System | Cl. 3.01.00 (A), Pg. 3/4 of 32 | Brine Concentrator & Crys-tallizer type | Brine Concentrator & Crystallizer type (including model no.) shall be finalised in DDE Stage based on sub-vendor recommendation. Please confirm. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |
| | Section-VI, Part-B, Sub-section-A-10-Project In-formation-Barh STPP Stage-I (3x660 MW) | Table-3,4, Pg. 29 of 30 | Table for Water Inlet Pa-rameters for FGD ZLD are not provided. | Water Inlet Parameters for FGD ZLD shall be considered as per ven-dor's past experience substantiated by data from their reference jobs, in DDE stage. However, equipment considered shall remain as speci-fied at this stage. | Technical specification requirement is clear. Bidder shall comply technical specification requirement. |
| | Section-VI, Part-B, Sub-section-A-11-Project In-formation-Nabinagar TPP (4x250 MW) | Table-3,4, Pg. 25 of 29 | | | |

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| SN | Vol/Section/Clause/ Page | Existing Specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|
| | Part A/SUB-SECTION-IV/ Page 2 | There are two ways for unloading of lime-stone-railway or truck. | Please confirm the way for unload-ing of limestone :<br>1) by existing CHP system or<br>2) by unloading with Road-Truck Un-loading system. | Technical Specifications is clear. Limestone will be re-ceived to power plant either through road by trucks and/or through Indian rail-way rakes.<br><br>Road unloading facility shall be provided for all the plants under this package. Wherever feasible, railway unloading shall also be pro-vided using existing Wagon |

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| SN | Vol/Section/Clause/ Page | Existing Specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|
| | | | | Tippler / Track Hopper as detailed out in the Technical Specifications. |
| | SECTION-VI | | Please provide the flow chart and general layout of Limestone handling system for reference. | Technical Specifications is clear'. Bidder is to propose the scheme in line with the requirements of technical specifications. |
| | Part A/SUB-SECTION-V/2.00&3.00 | Two tables about flue gas data. | The information of flue gas from MEJA-I 2X660MW has been listed twice in both tables. Please confirm which one is correct? | Bidder to refer necessary amendment in this regard. |
| | Part B/Sub-section-I-M1/3.02.04 | The duct from Absorber outlet to bypass duct shall be made of carbon steel of minimum 7mm thickness with 2mm thickness lining/cladding/wall paper of Alloy C276/Alloy 59 or better material. | As required in the bidding documents, the outlet of the absorber should be connected to the new wet chimney. So we are wondering what the material requirement for the duct between the outlet of absorber to the wet chimney? | Bidder to refer necessary amendment in this regard. |

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| SN | Vol/Section/Clause/ Page | Existing Specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|
| 1392. | Part A/SUB-SECTION-III-A5/2.01.01 & Part B/SUB-SECTION-I-M6 | Part A: 2 numbers box feeders/bulk-material receiving unit/underground truck unloading hopper/surface feeder….<br>Part B: The complete truck unloading system must not have any underground structures/facilities. | Whether the truck unloading system could have underground structure? | Noted. Necessary amend-ment shall be issued. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| SN | Vol/Section/Clause/ Page | Existing Specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|
| 1393. | | | The area left for FGD is too small to layout the whole FGD system. So do we have any other area for lime-stone handling? | Bidder to refer the revised GLP in issued amendments. |

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| SN | Vol/Section/Clause/ Page | Existing Specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|
| 1394. | Sec-VII ( Attachements 3K ) /Summery of Critical Equip-ments | Under this clause mentioned that ven-dor/sub vendor have, Designed /Manufactured /Got manufactured and supply at least one no of particular critical equipment type working in Wet Lime-stone based FGD application in Coal Fired Power Plant and which has been in suc-cessful operation for minimum one year | We inquire most of the listed critical equipments manufactured in India but they don't have previous supply-ing experience in Wet Limestone based FGD application pack-age.Please clarify the scope of ex-ception in this reference . | Specification requirement is clear. Bidder shall comply with the specification re-quirements. |
| 1395. | Sec-VIPart B Sub-Section-I-M9 ( MDL)/ List of Drawings | NTPC Drawings list | Listed Drawings are not available with existing tender documents .please provides the same. | Specification requirement is clear. Bidder shall comply with the specification re-quirements. |
| 1396. | | | Please confirm whether the chloride ion concentration in the slurry of absorber tank is specified. | Specification requirement is clear. Bidder shall comply with the specification re-quirements. |
| 1397. | | | Please confirm the design bounda-ries of limestone crushing and bun-ker feeding system, for the descrip-tion in Part B is not clear. Whether we could consider that all the sys-tem and equipment before truck un-loading system is not in the scope of | Technical specification is clear in this regard.<br>Bidder to refer Sub Section-4 , Terminal Points & exclu-sions, Section-VI, Part-A. |

| SN | Vol/Section/Clause/ Page | Existing Specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|
| | | | the bidder. See Part B Sub-Section-I-M6 page 2 of 73 for details. | |
| 1398. | Part A/SUB-SECTION-IV/ Page 2 | There are two ways for unloading of lime-stone-railway or truck. | Please confirm the way for unload-ing of limestone :<br>1) by existing CHP system or<br>2) by unloading with Road-Truck Un-loading system. | Technical Specifications is clear. Limestone will be re-ceived to power plant either through road by trucks and/or through Indian rail-way rakes.<br><br>Road unloading facility shall be provided for all the plants under this package. Wherever feasible, railway unloading shall also be pro-vided using existing Wagon Tippler / Track Hopper as detailed out in the Technical Specifications. |
| 1399. | SECTION-VI | | Please provide the flow chart and general layout of Limestone han-dling system for reference. | Noted. Detailed drawings of ex-isting facilities shall provided to the successful bidder. |

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| SN | Vol/Section/Clause/ Page | Existing Specification | Bidder's Query | NTPC Clarifications |
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| 1400. | | | Please confirm whether the new limestone crusher is locating in the space for FGD. | Query is not clear. |
| 1401. | | | Please confirm the material of the clean gas flue duct and lining if a new built wet stack plan is used. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1402. | | | Please inform us more information about the T.P of waste water. What HCSD means and where it is located? | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1403. | | | Please confirm the unloading facilities and new limestone crusher will be located in FGD area. | Technical Specifications is clear'. Bidder is to propose the scheme in line with the requirements of technical specifications. |
| 1404. | | | Please confirm whether the duct from absorber outlet to bypass duct is needed(part-B 3.02.04), and please inform us the material of the duct from absorber outlet to the new wet chimney. | Bidder to refer necessary amendment in this regard. |

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| SN | Vol/Section/Clause/ Page | Existing Specification | Bidder's Query | NTPC Clarifications |
|---|---|---|---|---|
| 1405. | Sec-VII ( Attachements 3K ) /Summery of Critical Equip-ments | Under this clause mentioned that ven-dor/sub vendor have, Designed /Manufactured /Got manufactured and supply at least one no of particular critical equipment type working in Wet Lime-stone based FGD application in Coal Fired Power Plant and which has been in suc-cessful operation for minimum one year | We inquire most of the listed critical equipments manufactured in India but they don't have previous supply-ing experience in Wet Limestone based FGD application pack-age.Please clarify the scope of ex-ception in this reference . | Specification requirement is clear. Bidder shall comply with the specification re-quirements. |
| 1406. | Sec-VIPart B Sub-Section-I-M9 ( MDL)/ List of Drawings | NTPC Drawings list | Listed Drawings are not available with existing tender documents .please provides the same. | Specification requirement is clear. Bidder shall comply with the specification re-quirements. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sr. No. | Section/Part/Chapter | Sub-Section / Annexure | Page No. | Clause No. | Bid Specification | Bidder's Query Dtd. 11-08-2017 | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | **Mechanical** | | | | | | |
| 1407. | TECHNICAL SPECIFICATION SECTION – VI, PART-A | SUB SECTION-III-A1 | Page2 of 9 | 3.01.01 | 2X100% Limestone storage silos each having minimum 24 hours storage capacity equivalent to the requirements of all the units. | The margin of the redundancy is much more than need. We propsal it should be 12 hrs. | Bidder shall comply with the requirements of Technical Specification. |
| 1408. | TECHNICAL SPECIFICATION SECTION – VI, PART-A | SUB SECTION-III-A1 | Page2 of 9 | 3.01.03 | Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limest one slurry storage requirement for of all the units at Design point, complete with all accessories and Agitator(s). | The margin of the redundancy is much more than need. We propsal it should be 6 hrs. | Bidder shall comply with the requirements of Technical Specification. |

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|---|---|---|---|---|---|---|---|
| 1409. | TECHNICAL SPECIFICATION SECTION – VI, PART-B | SUB SECTION-I-M1 | Page17 of 51 | 5.06.06 | Polysulfone or Stainless steel shall be provided... | PP is widely used and proven in China Market, so we suggest use PP as MOC of Mist Eliminator | Bidder shall comply with the requirements of Technical Specification. |
| 1410. | 0011-109-POM-A-001 | | | | Normal Quench System | Normally only Emergnecy quench system is there, No quench system would run all the time. Flue gas temperature would automatically drop inside the absorber. We suggest cancel normal quench system | Normal Quench System is not necessary if it is the proven practice of the Bidder. |
| 1411. | 0011-109-POM-A-001 | | | | **FS/TT/AP/TS/PP/TP/PG** | Instrument with such abbrevation is not clear, please clarify. | Below are the clarification for the abbrevation:<br>FS: Flow Switch<br>TT: Temperature Transmitter<br>AP: Analyser (test) pocket<br>TS: Temperature Switch<br>PP: Pressure (Test) pocket<br>TP: Temperature (test) |

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| Sr. No. | Section/Part/Chapter | Sub-Section / Annexure | Page No. | Clause No. | Bid Specification | Bidder's Query Dtd. 11-08-2017 | NTPC Clarifications |
|---|---|---|---|---|---|---|---|
| | | | | | | | pocket<br>PG: Pressure Gauge |
| 1412. | 0011-109-POM-A-001 | | | | Redundant motor and pneumatic valve before Emergency water tank | We suggest only one motor valve and one pneumatic valve is suffcient for emergency water tank inlet. | Bidder shall comply with the requirements of Technical Specification. |
| 1413. | 0011-109-POM-A-001 | | | | Density Monitor & pH Analyser | We suggest that density monitor and pH analyzer should not be located right on the absober. Bidder would do modification as per proven practice. | The location of density monitor and pH analyser shall be as per the bidder's standard and proven practice. The same shall be discussed and decided during detailed engineering. |
| 1414. | 0011-109-POM-A-001 | | | | Flushing pipe pneumatic valve | Due to flushing point is distributed, instrument air line is difficult to arrange, we suggest all the flushing pipe valve motor driven. | Bidder can provide motor driven flushing pipe valves as per proven practice of the Bidder. |

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| Sr. No. | Volume/ Chapter | Clause No. | Page No. | Bid Specification | Bidder Clarifications | NTPC Clarifications |
|---|---|---|---|---|---|---|
| 1454. | IV | 3.14.01 | 10 of 69 | ".....Chimney shall be reinforced concrete construction. There shall be one flue (liner) for each unit....." | the Bidder shall design according to his knowledge a proper wet stack design, considering EPRI design requirements. The wet stack can be (i) top mounted on the absorber with no additional supporting structure, (ii) top mounted on the absorber with additional supporting structure located around the absorber, (iii) located aside the absorber with a proper supporting structure of the flue pipe. The flue pipe material shall be selected according to Bidders knowledge and experience (FRP, CS lined). The Bidder shall focus on a reliable and economical solution of the wet stack system. Kindly clarify | Bidder shall comply to the requirements of technical specification. |

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| Sr. No. | Volume/ Chapter | Clause No. | Page No. | Bid Specification | Bidder Clarifications | NTPC Clarifications |
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| | | | | | and confirm. | |
| 1455. | PART-B-I-MECH.(SUB SEC.-I-M1) | 3.02.07 | 6 OF 51 | "...The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal flue liner...." | The flue of the wet stack shall be made from FRP or CS with flake lining. The Bidder shall focus on a reliable and economical solution of the wet stack system. Kindly clarify and confirm. | Bidder shall comply with the requirements of Technical Specification. |
| 1456. | | | | Lot 1 A projects | In general most of the plants sufficient space is not sufficient. We request client to give crushed lime stone with (-)20 mm size near FGD area. Kindly clarify and confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements.<br><br>Also, Bidder to refer the revised GLP in issued amendments. |
| 1457. | | | | General | Kindly give in word format all the technical data sheets, schedules etc. which is to be submitted as part of offer. | Data sheets are all ready part of the Tender document. |

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| **MECHANICAL** | | | | | |
| 1458. | DWG No: 011-109-POM-A-003 | | On the discharge of Sump pump for Lime-stone Grinding area Sump NRV is envis-aged | As these pump are expected to handle leakoff slurry, pump shall be provided without NRV on pump discharge | Bidder shall comply with the specifica-tion requirement. |

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| S.No | Clause No | Page No. | Description of Bid Document | Bidders Queries/Suggestions | NTPC Clarifications |
|---|---|---|---|---|---|
| 1459. | DWG No: 011-109-POM-A-002 & DWG No: 011-109-POM-A-003 | | Discharge of Sump Pump for Limestone Grinding Area Sump | As per DWG No: 011-109-POM-A-002 discharge of Sump Pump for Limestone Grinding Area Sump to be taken to Limestone Slurry Storage Tank Whereas as per DWG No: 011-109-POM-A-003 same is to be taken to Absorbent tank. Owner to clarify discripancy. | Discharge of Sump Pump for Limestone Grinding Area Sump shall be taken to Limestone Slurry Storage Tank. |
| 1460. | DWG No: 011-109-POM-A-003 | | Level Control Station For Tank | We understand common Level control station to be provided for both process water tanks.<br>Owner to confirm. | Bidders understanding is correct. |
| 1461. | Section-VI/ PART-A /Sub section-III, 1.04.00 | 1of 5 | Paints & Painting | It is to be noted that some of the equipments/ systems are being imported. In International market, RAL or BS color coding is being adopted for specifying colors. In view of this RAL & BS color coding system is to be allowed | Noted. Will be dealt as per tender technical specifications. |
| 1462. | Section-VI/ PART-A /Sub section-III, 1.04.00 | 2 0f 5 | Paints & Painting | For ducts and surfaces wherever Insulation is being used painting specification as per Sr. no (i) and (ii) shall only be used. | Bidders query is not clear. |
| 1463. | Section-VI/ PART-A /Sub section-III,A1, 2.04.00 | 2 of 9 | ..... Contractor shall terminate the Flue Gas Duct (at a suitable point on the common flue gas duct to Chimney- upstream of the chimney terminal point and outside the chimney) | We understand common flue gas duct upto existing chimney shall be provided by owner. FGD contractor shall suppy & Erect bypass dampers & instruments on this duct. Owner to con- | Bidders understanding is correct. |

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| | | | | firm. | |
| 1464. | Section-VI/ PART-A /Sub section-V, 2.0.00 & 3.00.00 | 3 of 26 & 3 of 26 | Guarantee Point & Design Point Data | In both claused 2.00.00 & 3.00.00 Meja -I, 2X660MW power project is mentioned. Please clarify which data is to be considred for MEJA-I Power plant. | Refer necessary amendment in this regard. |
| 1465. | Section-VI/ PART-A /Sub section-III,A1, 6.01.00 | 5 of 9 | Employer shall provide a common Auxilary Absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. | Clarify scope & Location of Auxilary absorbent tank | For scope, Refer necessary amendment in this regard.<br>Regarding location , Bidder to finalize the same based on the Bidder site visit , revised GLP and system design. |
| 1466. | VI, Part-A, Sub-Section-IV1.00.00 | 1 of 3 | Terminal Point | Isolation valve at terminal point for , Potable water DM water, Clarified water, Fire water & Instrument & Service air shall be provided by owner.Owner to clarify | Isolation valve at terminal point for , Potable water DM water, Clarified water, Fire water & Instrument & Service air shall be provided by the FGD Contractor. |

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| 1467. | Section-VI/ PART-A /Sub section-IV-1.02.00 | 1 of 3 | Terminal point: One tapping from the common flue gas duct going towards the existing chimney ( in case of twin flue chimney) | i) As per this clause it one tapping from common flue gas duct is envisaged for FGD tapping However as per drawing 0011-109-POM-A-101, two nos are tapping are envisaged from each ID fan discharge duct for FGD tapping. NTPC to clarify for twin flue chimney what shall be tapping point.<br>ii) In case tapping is from common duct NTPC to clarify whether isolation damper is required at tapping point Or Not. | One tapping from the common flue gas duct going towards the existing chimney is to be taken for FGD. Isolation Gate is to be provided by the FGD Contractor. |
| 1468. | Section-VI/ PART-A /Sub section-IV-2.00.00 | 3 of 3 | Exclusions | Please provide list of Exclusions. | The scope for FGD is on complete EPC basis and is specified in the Technical Specifications. |
| 1469. | Section-VI/ PART-A /Sub section-III-A4 | 1 of 3 | Hot secondary water pipe from the PHE's, discharging into the FGD System as process water | i) As such requirement of secondary cooling water shall be very small, In view of this NTPC to clarify whether entire process water tapped from blowdown line is to be passed through ECW system PHE or only partial flow as per system requirement can be passed through PHE.<br><br>ii) Process water may be used before OR after process water storage tank as per layout requirement. | i) Specification requirement is clear under the referred Sub section-III-A4. Bidder shall comply with the specification requirements.<br><br>ii) Bidder shall select accordingly offer his design meeting the layout & specification requirements. |

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| | | | | | |
| 1470. | Section-VI/ PART-A /Sub section-III-A5,1.02.02 | 3 of 6 | NTPC reserves the right to freeze a basic layout for each NTPC plant post techno commercial discussions. | We understand NTPC will provide finalized basic layout before submission of commercial bid & it will be provided to bidders well in advance before submission of commercial bid. Please clarify. | Technical Specifications is clear. NTPC reserves the right to freeze a basic layout for Limestone and Gypsum handling for each NTPC plant post techno-commercial discussions as specified in the subject clause. |
| 1471. | Section-VI/ PART-A /Sub section-III-1.06.00 | 3 of 5 | All the first fill and one years topping requirements of consumables such as grease, oil lubricants servo fluid etc. which will be..... | i) We understand this one year topping requirement includes, toppings required during commissioning, trial runs, initial operation etc.<br>Ii) We understand consumables required for maintenance of equipment of equipment are to be supplied. Chemical required for the process are excluded from bidders scope.<br>NTPC to clarify. | i) Specification requirement is clear under the referred cl.no. 1.06.00.<br>. Bidder shall comply with the specification requirements.<br><br>ii) Except Limestone, other chemicals required shall be in Bidder's scope. |

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| S.No | Clause No | Page No. | Description of Bid Document | Bidders Queries/Suggestions | NTPC Clarifications |
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| 1472. | Section-VI/ PART-B/Sub section-I- M1-2.00.0 | 5 of 51 | ..... Complete installation of liners shall be made under supervision of the liner supplier as per their guidelines..... | Liners used in the FGD system are standard lines & shall be installed as per standard guidelines of manufactures without supervision of supplier. | Bidder shall comply with the requirement of Technical Specification. |
| 1473. | Section-VI/ PART-B /Sub section-I-M1-3.01.0, Sr. No-2 | 5 of 51 | The Entire Flue Gas system , Flue Gas Ducts, Absorber shall be designed to meet following conditions :<br>Sr. No 2 : Design Inlet Gas Temp : 150 deg. | We understand design inlet gas temp to absorber is 150 deg.. Please clarify. | Specification requirements are clear in this regard. |
| 1474. | Section-VI/ PART-B /Sub section-I-M1-3.01.0, Sr. No-2 | 5 of 51 | The Entire Flue Gas system, Flue Gas Ducts, Absorber shall be designed to meet following conditions :<br>Sr. No 1 : Design Internal pressure at 67% yield strength : +660 & -150 mmwc or Maximum conceivable head of booster fan , Whichever is higher. | As per clause no 16.01.03 , all the flue gas duct shall be designed for +/- 660mmwc or maximum conceivable pressure of the relevant fan.....<br>NTPC to clarify design pressure on -ve side to be considered for duct design. | Refer necessary amendment in this regard. |
| 1475. | Section-VI/ PART-B /Sub section-I-M1-3.02.04 | 5 of 51 | The duct to absorber inlet shall be made of carbon steel of minimum 7mm thickness. The duct , from Absorber outlet to bypass duct shall be made of carbon steel of minimum 7mm thickness with 2mm(minimum) thickness lining / cladding / wallpaper of alloy C276/Alloy 59 or better material. | It is to note that as Absorber outlet is connected to dedicated chimney, there is no connection from absorber outlet to bypass duct & requirement indicated for absorber outlet to bypass duct is not relevant. NTPC to clarify. | Refer necessary amendment in this regard. |

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|---|---|---|---|---|---|
| 1476. | Section-VI/ PART-B /Sub section-I-M1-3.03.07 | 7 of 51 | Quick acting biplane damper shall be provided by the contractor……. The damper shall be capable of quick opening during emergency condition within a time of 10-20sec. Bidder should indicate the required opening time for ……. | i) As quick opening biplane damper is to be provided, Guillotine gate damper will be redundant, in view of this it is proposed to provide only quick opening biplane damper in bypass duct.<br>ii) In case if bypass guillotine gate type damper is to be provided in the existing duct. It is proposed that opening time of biplane damper shall be same as that of guillotine gate type of damper. | Bidder shall comply with the requirement of Technical Specification. The opening time of guillotine gate can be more than that of quick opening biplane damper. |
| 1477. | Section-VI/ PART-B /Sub section-I-M1-3.03.09 | 7 of 51 | The dampers shall be pneumatically operated and controlled from the control room……. | As per P&ID 0011-109-POM-A-001(a) , Guillotine gate type dampers are to be provided with motorised actuator.NTPC to clarify discripancies in the type of actuator to be provided | This is a general clause. Bidder to however refer the subject tender P&ID for the type of drives on gates/dampers. |
| 1478. | Section-VI/ PART-B /Sub section-I-M1-4.01.00-(iv) & 4.02.00-(viii) | 9 of 51 & 10 of 51 | Gas Temp ( Deg C) = 150 | We understand this is the temperature of the gas being handled by Booster fan including temperature rise in the booster fan. | Bidder's understanding is correct. |

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| 1479. | Section-VI/ PART-B/Sub section-I- M1-7.08.01 | 29 of 51 | ..... It should be possible to discharge the each absorber into the emergency drain tank within 2 hrs. | As per present scheme envisaged in the technical specification Gypsum bleed pump shall be utilized for emptying of absorber tank. Capacity of this pump will not be adequate to transfer entire slurry in absorber tank within 2 hours. If entire absorber tank slurry is to be transferred within 2 hours then separate pumps are to be provided for this purpose. NTPC to review & clarify. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1480. | Section-VI/ PART-A /Sub section-VI-5.00.00-xiii | 21 of 24 | xiii)Auxilary Cooling (Normally working)water pump set one (1) to supply cooling water on secondary side of the PHE..... | In case if discharge of booster pump is passed through PHE then separate Auxiliary Cooling water pump shall not be used therefore , power consumption of Auxiliary Cooling water will not applicable in this case.. | All working Booster / FGD Auxiliary (secondary) cooling water pumps shall be considered for calculation of power consumption.<br><br>May please refer amendment. |
| 1481. | Section-VI/ PART-A /Sub section-VI-7.00.00 | 23 of 24 | The contractor shall guarantee 98% availability of FGD plant including..... For a continuous period of 120 days. An availability guarantee test shall be conducted to assure this level of availability for a period of 240 days as per the procedure below. | Please clarify if availability test is for 120 days Or 240 days. | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1482. | Section-VI/ PART-B /Sub section-I-M1-5.06.18-(i) | 20 of 51 | The last spray level upstream the mist eliminator shall be operated only in counter-flow | In DW Tower also known as Liquid Column Desulfurization Tower liquid column shall be injected from bottom i.e. in co-current fashion.<br>This is a standard proven design for FGD absorber. | The requirement is applicable for spray tower design. In case, Bidder other design the same shall be discussed with the bidder during post bid meeting after submission of techno-commercial bid. |

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| | | | | Owner is requested to modify this clause accordingly. | |
| 1483. | Section-VI/ PART-A /Sub section-V-5.01.00 | 8 of 26 | ..... The chimney flue liner cladding shall be made of 2mm thick Titanium( Grade 2 as per ASME SB265) Or C276 alloy over 8mm thick (minimum) mild steel base metal of flue lines..... | It is proposed to provide borosilicate block lining for the chimney flue. NTPC is requested to allow for Borosilicate lining for the chimney. | Bidder to refer necessary amend-ment in this regard. |
| 1484. | Section-VI/ PART-A /Sub section-VII | | | Not applicable line items shall not be provided by bidder, if same are not applicable in bidder's design/ Supplied Equipment.<br>Owner to confirm bidder understand-ing is correct. | Bidder shall comply with the require-ments of Technical Specification. |
| 1485. | VI, Part-C<br><br>30.00.00 | 42 of 83 | Noise Level:-<br><br>.....shall not exceed 85 dBA. However Ball Mills the noice levels as per following shall also be acceptable:<br>a) Ball Mill < 90 dBA | i) As per clause no 9.01.00, Sr. No-6, on page no 21 of 26, Section VI, Par-tA, Sub Section V, Noise level for Air Compressor is 90 dB.<br>ii) It is proposed that noise level for Crusher shall be < 102 dBA<br>Owner to clarify. | please refer amendment in this regard. |
| 1486. | General FGD Area Layout | | Pipes & Cables | Owner to provide routings of existing pipes & cables which may be laid in the allocated area for FGD system. | Bidder to refer list of drawings provided at of Sub Section- II- PROJECT INFOR-MATION (For Various Projects) Section – VI, Part-A for pipe/cable trestle draw-ings. |

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| S.No | Clause No | Page No. | Description of Bid Document | Bidders Queries/Suggestions | NTPC Clarifications |
|---|---|---|---|---|---|
| 1487. | General FGD Area Layout | | Pipe Rack / Trestle | Contractor shall use employers pipe rack/trestle to support their pipes and cable trays from employer TP point location to FGD area.Owner to con-firm bidder understanding is correct. | Stipulations, as given under Clause 14.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles.<br>-Bidder shall comply with technical specification requirement clause no: -1.08.00.2 Sub Section- III-B, Section –VI, Part-A. |
| 1488. | General | | ID fan Performance Curves | Owner to provide ID fan performance Curve. | Noted. ID fan performance Curve will be provided to the successful bidder. |
| 1489. | General | | Code & Standard | As equipment may be proccurent from China,<br>i) Equivalnet GB standard shall be fol-lowed for Design of equipment of FGD System like structure, pumps, sup-ports etc.<br>ii) Material shall be as per equivalent Chinese code. | Specification requirement is clear. Bid-der shall comply with the specification requirements. |
| MECHANICAL-Water System | | | | | |
| 1490. | SECTION – VI, PART-A SUB-SECTION-III-A1 FGD CL 1.03.00 | 1 of 9 | The contractor's scope shall include,,, common limestone grinding system... | A common limestone, unloading, stor-age, grinding, slurrification and dosing system for FGD and ZLD systems is proposed . This would reduce foot-print and contain capital costs. Please clarify & confirm. | Specification requirement is clear at CL 1.03.00. Bidder shall comply with the specification requirements. |

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| 1491. | SECTION – VI, PART-A SUB-SECTION-III-A6 ZLD Cl 1.01.00 | 1 of 3 | Pre treatment system shall consist of FGD waste water storage tank (2x50%) to store FGD waste water, GGH washing water, etc | Bidder proposes 1x100% tank sized for 30 m3/h inflow (Barh-I) and 20 m3/h inflow (Nabinagar) instead of 2x50% tanks, this will facilitate the operation flexibility. Please confirm.<br>Also please clarify all the waste water sources leading to ZLD, such process wastes, cooling water wastes, if any. | Stipulations of technical specification is clear. As mentioned in Cl. No. 1.01.00, Sub-section IIIA-6, Part-A, Bidder shall provide Pre-treatment system consisting of 2x50% FGD waste water storage tank for storing FGD wastewater, GGH washing water etc.<br>As such, any waste water as envisaged by Bidder shall be considered while designing the Waste storage tank. |
| 1492. | SECTION – VI, PART-A SUB-SECTION-III-A6 ZLD Cl 1.02.00 | 1 of 3 | Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system. | Bidder proposed to provide 1x100% Evaporative Concentration System. Please confirm. | Specification requirement is clear under the referred cl.no. 1.02.00 . Bidder shall comply with the specification requirements. |
| 1493. | SECTION – VI, PART-A SUB-SECTION-IV Terminal Points & Exclusions Cl 1.08.00 | 2 of 3 | FGD waste water pipes shall terminate allong with isolation valve at 5 meters near HCSD mixing tank | We presume this is not applicable in Barh & Nabinagar since ZLD is provided. Please clarify. | Bidders understanding is correct. |
| 1494. | SECTION – VI, PART-A SUB-SECTION-IV Functional Guarantees & LD Cl 4.02.00 | 18 of 24 | Waste Water: The contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10 m3/h averaged over a 24 hour period for each unit. | Please clarify whether the guaranteed purge quantity mentioned as 10 m3/h per unit is common for all the projects.<br>Please clarify the exact flow rate to be considered for designing the ZLD. | Bidder to refer necessary amendment in this regard. |

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| 1495. | SECTION – VI, PART-ASUB-SECTION-III-A6ZLD Cl 1.02.00 | 1 of 3 | Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system. | Bidder proposes the hybrid ZLD system. The system comprising of Primary secondary clarifiers followed by 2X50% streams of UF & RO system.Further reject will be fed into the downstream consisting of evaporator and crystalliser as in NTPC specification with reduced capacities.The proposed system is technoeconomical & proven system. This type of scheme is already proposed in FGD system by leading consultants of india. Please review & reply. | Bidder shall comply with Technical specification requirement. |
| 1496. | SECTION – VI, PART-C General Technical Requirements Cl 30.00.00 | 42 of 83 | Noise levels <85 dBA for FGD equipment and <90 dBA for Ball Mills | Please clarify the acceptance of noise levels for ZLD equipment - near field & far field. | Bidder shall comply with Technical specification requirement in Section VI part-C. |
| 1497. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl 2.00.00 | 3 of 32 | Conditions of Service - 'All Design Pressure of all device, piping, and auxiliary facilities...Device and tank maximum allowance: operating pressure x 1.5' and also ' piping and auxiliary facilities: 150 lb class flange, STD wall pipe' | This may not apply for larger "fit for service" equipment like Evaporators and Crystallizers. The same will be based on manufacturer recommendations on design pressures for piping and tanks based on proven experience in the past executed project. Please confirm. | Technical specification requirement is clear. However, proven practice of OEM is also acceptable which shall be decided during detailed engineering. |

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| 1498. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl E2 | 9 of 32 | Evaporative concentrator shall be designed to start / stop every day | Please clarify the requirement, it is presumed that FGD & ZLD will operate at full capacity continuously. | Bidder shall comply Technical specification requirement. |
| 1499. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl E6 | 9 of 32 | Pressure vessel in evaporative concentration shall be designed as per ASME Sec VIII or equivalent code listed above. | Evaporator is typically not a pressure vessel and not necessarily designed as per ASME Sec VIII. Kindly accept the manufacture standard practice. | Technical specification requirement is clear. Any pressure vessel in evaporative concentration shall be designed as per ASME Sec VIII or equivalent code. However, for evaporator, proven design and experience meeting provenness criteria specified in tender is acceptable. |
| 1500. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl E14 | 10 of 32 | Hoists shall be provided for all vessels in evaporative concentration system as per the Manufacturer's proven practice | Manufacturer recommended practice will be followed for handling / maintenance. Please confirm. | Technical specification requirement is clear. However, proven practice of handling and maintenance of OEM is also acceptable which shall be decided during detailed engineering. |
| 1501. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl E15 | 10 of 32 | Vessel support shall be designed same as materials for vessel. Different material cannot be welded to vessel. | Manufacturer proven practice of providing the supports of same/different material as the vessel will be followed. Please confirm. | Vessel support arrangement as per proven practice of OEM is also acceptable which shall be finalized during detail engineering. |
| 1502. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl F2 | 10 of 32 | Centrifuge to dehydrate solids form evaporative concentration shall be consist of Centrifuge 2x50% | Centrifuge does not 'dehydrate solids' it makes wet cake or solids suitable for landfill. Please review & confirm, | Bidder's query is not clear. Bidder shall comply Technical specification requirements. |

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| 1503. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl 22d | 14 of 32 | Size: 1/2%-inchOD minimum | As per the manufacture standard , minimum suction size is 1/4" OD tube. Kindly accept the same. | This shall be finalized during detail engineering. |
| 1504. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl 3.02.01(4) | 15 of 32 | ...the contractor shall provide duplicate pumps (2x100%) or multiple standby pumps for the same service. | Duplicate pumps are not needed for all pumps. As per the OEM recommendation the applicable connected redundancies and store standbys are considered.Please confirm. | Redundancy with store standby of Pumps as per the proven practice of OEM is also acceptable which shall be decided during detailed engineering. |
| 1505. | SECTION – VI, PART-BSUB-SECTION-I-M7ZLD Cl 3.02.03 (2) | 20 of 32 | Slurry tanks shall be provided with screen at the inlet nozzles. | It is proposed to follow as per the manufacturer standard practice. Screens if required will be provided to protect downstream equipment (such as heat exchangers) as per the proven experience. Please confirm. | Technical specification requirement is clear. However, proven practice of screens for slurry tanks of OEM is also acceptable which shall be decided during detailed engineering. |
| 1506. | SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl 3.02.05 (6) | 20 of 32 | Additional required equipment for Vapour Compressor :<br>i) Shaft driven lube oil pump | As per the OEM/manufacturer electrically driven lube oil pump is proposed instead of shaft driven due to limitations in design of certain compressor manufacturers. Please confirm. | Electrically driven lube oil pumps as per the proven practice of OEM is also acceptable which shall be decided during detailed engineering. |
| 1507. | Process Flow Diagram ZLD | 3 of 3 | | The scheme shows steam driven crystalizer, whereas write up calls for MVR. Please clarify. | As mentioned in Cl. No. 2.00.00 D, Subsection I-M7, Part-B, Auxiliary steam if required shall be provided by owner for start-up condition only.<br>For continuous duty, Bidder to design |

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| | | | | | the various systems considering power driven equipment and the same shall be considered in power guarantee. |
| 1508. | SECTION – VI, PART-A SUB-SECTION-IIA-A10 PROJECT INFORMATION BARH STPP STAGE-I (3X660) | 18 of 30 & 28 of 30 | Cooling water Analysis Table 4: Clarified water analysis | The cooling water analysis & table 4 clarified water analysis are contradictory. The COC mentioned cooling water analysis is 2.5, COC 5-5.5 was mentioned in table 4. Bidder is following the Table 4 water analysis & COC as 5-5.5. Please confirm. | Confirmed. Bidder to follow the Table 4 water analysis & COC as 5-5.5. |
| 1509. | SECTION – VI, PART-A SUB-SECTION-III-A6 ZLD Cl 1.04.00 i) | 3 of 3 | All first fill & One year topping requirement of consumable such as chemicals, grese….etc | It is proposed to provide the chemicals till commissioning & handing over of the plant. The Three(3) months chemicals at rated capacity are considered for the proposal. Please confirm. | Bidder shall comply with Technical specification requirement. |
| 1510. | SECTION – VI, PART-A SUB-SECTION-III-A6 ZLD Cl 1.01.00 | 1 of 3 | Sludge dewatering etc | Sludge dewatering followed by sludge/cake disposal shall be by client. Please confirm. | Technical specification requirement is clear at Cl 1.01.00. Bidder shall comply with Technical specification requirement. |

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| 1511. | SECTION – VI, PART-A SUB-SECTION-I INTENT OF SPECIFICATION CL 4.04.00 & 4.05.00 | 15 of 19 & 16 of 19 | Route-1, Route 2 & provenness criteria for critical equipments.... | The main qualifying requirements are mentioned in Route-1 & Route-2. Additionally proveness criteria for critical equipments are indicated in the clause for evaporator, crystalliser etc. It is proposed to consider either of the two qualifying/provenness criteria is applicable. Also the equipment application shall not be restricted to only coal fired power plant. As wide application implementation in process industries may be considered for evaluation. | Bidder to refer clarifications being issued separately. |
| MECHANICAL-Material Handling System | | | | | |
| 1512. | Technical Specification,Section-VI,Part-A, Subsection-III-A3,Fire Fighting System, Clause no:1.00.00 | Page 1 of 2 | Fire water shall be tapped off from Existing Fire Water main header for Hydrant and Spray system. | It is requested to mark the terminal point in Plant layout drawing. | Terminal point for Hydrant and Spray Header shall be furnished during detailed engg. However for details, Bidder to refer Cl. No 1.11.00 , sub-section -IV, Part A of Technical Specification, Section VI. |
| 1513. | Technical Specification,Section-VI,Part-A, Subsection-III-A3,Fire Fighting System, Clause no:1.00.00(point no 1.1,1.2,1.3) | Page 1 of 2 | Fire water shall be tapped off from Existing Fire Water main header for Hydrant and Spray system. | Owner is requested to provide the pressure available at terminal point for both Hydrant & Spray system. | Bidder to refer Cl. No 1.11.00 , sub-section -IV, Part A of Technical Specification, Section VI. |

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| 1514. | Technical Specification,Section-VI,Part-A, Sub-section-III-A3,Fire Fighting System, Clause no:1.00.00(point no 1.2,1.3) & Technical Specification,Section-VI,Part-B, Sub-section-I-M4,Fire Fighting System, Clause no:3.01.00 | Page 1 of 18 | Fire water shall be tapped off from Existing Fire Water main header for Spray system. & Spray System shall be provided with Spray Pump. | We will design the Spray system considering the tapping point from existing system. Necessary Orifice shall be provided(if required). No Spray pump has been considered. Please confirm. | Noted |
| 1515. | Technical Specification,Section-Vi,Part-A, Sub-section-V,Salaient Design Data & Sizing, Clause no:8.02.00 | Page 18 of 26 | The Pipelines routed in RCC Trenched shall be provided with Coating & wrapping. | As per practice Coating & wrapping is not required for the pipes which is laid in the trench and open to Air. Outside paint for the pipe shall be provided. Owner is requested to confirm. | Bidder shall comply specification requirement. |
| 1516. | Technical Specification,Section-Vi,Part-A, Sub-section- | Page 18 of 26 | The Pipelines routed in RCC Trenched shall be provided with Coating & wrapping. | It is proposed to provide pedestal instead of Trench. Wherever pedestal is not possible, Trench will be provided. Please confirm. | Meaning of the referred clause is amply clear. Query asked is not related to the referred clause. |

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| | V,Salaient Design Data & Sizing, Clause no:8.02.00 | | | | |
| 1517. | Technical Specification,Section-VI,Part-B, Sub-section-I-M6,LHP, Clause no:3.2.00 | Page 2of 73 | Limestone shall be conveyed using same conveyors as for coal before being taken to dedicated limestone crusher house. | We are not considered Fire Figthing system for Existing Conveyor for LHP. If Additional conveyor or any modification will done for FGD system, Fire fighting System will be provided for that additional system only.<br>Please confirm. | Confirmed. |
| 1518. | | | | R-Infra consider the various areas which are mentioned in the Plotplan dedicated for FGD system . No other area has considered by us.<br>Owner to confirm. | Confirmed. |
| 1519. | | | | Owner is requested to provide the scope and terminal point for Service Air, Instrument Air, Service Water for FPDS system. | Specification requirements are clear. Bidder shall comply with the specification requirements. |
| 1520. | Section-VI, Part-B, Sub-section-I-M6, Clause No. 4.10.0 | 140 of 274 | Vibrating feeder shall be of electromechanical type and shall be provided to feed limestone to crusher. While in same same sub-section-I-M6, Clause No. 3.3.0, page 129 of 274 two (2) numbers of Vibrating grizzly/screening feeders. | Please clarify whether we shall consider vibrating feeder or Vibrating grizzly/screening feeder. | Vibrating screening feeder shall be considered for limestone crusher house. Necessary amendment shall be issued. |

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| 1521. | General | | | Please provide existing Coal flow diagram and transfer tower AS built GA drawings before crusher (editable copy) for preparing new layout for Lime Stone handling System. | General Layout Plan of the plants is already given in the tender documents. Other drawings like Coal Flow Diagram and Transfer Tower GA, if required, shall be provided to successful bidders. |
| 1522. | General | | | What shall be the belt conveyor system capacity, belt width and belt speed to be selected. Please clarify. | Rated capacity for belt conveyor system taking feed from existing CHP shall be 1200 TPH. However, for road truck unloading system rating of belt conveyor system shall be 150 TPH. Necessary amendment shall be issued. |
| 1523. | Part-B, Volume VI, Sub Section-I-M, FGD system Clause 6.06.01 | Page 24 of 51 | For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower. | Please allow the concentration to be decides by vendor as per their technology for overall optimization. | Bidder shall comply with the requirements of Technical Specifications. |
| 1524. | Part-B, Volume VI, Sub Section-I-M, FGD system Clause 6.02.05 | Page 21 of 51 | For dust free operation each silo should be provided with a covering arrangement and a self cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc | Considering the clean air requirement for bag purging, we recommend for Instrument air tol be used for cleaning of bags of bag filters in place of blower. Please relook into the requirement of blower and confirm. | Bidder shall comply with the requirements of Technical Specifications. |
| C&I | | | | | |

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| 1525. | Section-VI, Part-A, Sub Section-III-C, Cl: 2.01.00 (c), (d) | 2 of 8 | For binary and analog inputs required in major equipments of FGD system, protection triple-sensing devices shall be provided.<br><br>For other critical binary and analog inputs …….. Triple sensors shall be provided. | It may not be possible to provide 2 out of 3 configuration for all the interlocks of HT drives/ other equipment due to mechanical/ space constraints in drives such as motor winding, motor/ fan/ pump bearing temperature etc. In such cases, single sensors only will be envisaged, e.g. 1 duplex RTD for each bearing/ winding phase.<br><br>Owner to confirm concurrence in view of the reasons cited. | Bidder's proposal is not acceptable. Bidder shall comply with the specification requirement. |
| 1526. | Section-VI, Part-A, Sub Section-III-C, Cl: 4.00.00 (d), (e)<br>&<br>Section-VI, Part-E, Drawing no: 0000-101/102-POI-A-021 | 5 of 8<br><br>&<br>Sht 1 of 3 | d) Cables required for interfacing……. Shall be in bidder's scope.<br>e) Cables for connectivity of CEMS……. Shall be in bidder scope.<br>&<br>As per cable scope diagram all cables from JB/ Integral JB etc to Owner control system is in the scope of Owner. | Owner may please clarify which clause/ drawing to be followed for cabling to Owner's Control system.<br><br>Owner to confirm. | Refer amended tender drawing in this regard. |

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| 1527. | Section-VI, Part-A, Sub Section-III-C, Cl: 6.00.00 | 6 of 8 | Control System | Bidder proposed to provide common PLC (hot redundant) for each Project FGD along with required number of unitized/ common RIO cabinets at CER, gypsum handling, Limestone handling system etc meeting all functional and parametric requirements of the specification.Owner may please confirm concurrence | It is clarified that binary and modulating controls of complete Flue gas desulphurization system, associated material handling systems etc. and other systems being provided under the contract shall be implemented in PLC. The PLC based Control System shall have separate process blocks for unitised system and one process block for common system including material handling system. For example in KUDGI-I (3x800MW) , the PLC based control system shall have following process blocks:(i) Unit-1 FGD and associated system(ii) Unit-2 FGD and associated system(iii) Unit-3 FGD and associated system(iv) Common system including material handling systems.Refer amendment in this regard.Remote Input Output (RIO) panel, located in respective unit (s) CER, for hardwired signal exchange between FGD PLC and BOP DDCMIS of respective unit shall be provided on per unit basis. |
| 1528. | Section-VI, Part-A, Sub Section-III-C, Cl: 6.01.00 | 6 of 8 | Dual processor based PLC system with PC based OWS, programmable station and A4 size color laser printer etc on as required basis (to be decided during detail engineering) | It is understood that OWS, EWS cum OWS, printer are to be provided in line with PLC configuration diagram (0000-151-POI-A-013) and not "on as required basis". | Bidder's understanding is not correct. Bidder to refer clause 6.01.00, PART-A, Sub Section-IIIC, where in it is mentioned that Operator Work Station (OWS) shall be supplied on as required |

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| | | | | Owner may please confirm concurrence | basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS).<br>However, bidder to consider minimum quantity of OWS and OWS cum EWS as follows:<br>a) OWS (placed in FGD control room)-(N+1) where N is the total number of generating units per project under this package.<br>b) OWS cum EWS (placed in FGD control room)-ONE (1)<br>c) OWS (placed in central control room of each generating unit)-TWO (2).<br>Bidder to refer amendment in this regard. |

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| 1529. | Section-VI, Part-A, Sub Section-III-C, Cl: 6.05.00 | 6 of 8 | The minimum quantity of furniture per unit envisaged in FGD control room is as:<br>a) Chairs- 4nos<br>b) Printer Table- 1no<br>c) Computer Table- 2nos<br>-<br>e) Locker set - 1 no | The following is understood from the Tender documents:<br>1) Computer Table is asked in scope of supply, however no specification for computer table is provided and instead specificaion of Control desk is indicated at III C-5, which is not applicable as per scope. It is understood that computer table is to be provided as per standard practice of OEM.<br>2) As common control room is envisaged for each project, it is understood that the quantity of furniture indicated is common for all units of each project.<br>3) Provision for mounting FGD OWS in Owner's CCR (i.e.Computer table/ space in Owner's existing desk) shall be provided by Owner.<br><br>Owner may please confirm concurrence to above Understanding of the Bidder. | 1) It is clarified that control desk meeting specification requirements stipulated in clause 10.04.00, PART-B, Sub Section III-C5 of technical specification is in the scope of bidder. Refer amendment in this regard.<br>As per specification clause 6.05.00, PART-A Sub section IIIC, computer table is also in the scope of bidder and the same shall be supplied as per bidder's standard and proven practice.<br>2) Bidder's undersatnding is not correct. It is clarified that the quantity of furniture mentioned in clause 6.05.00 a) to e) is on per unit basis. For example: In case of MOUDA-II (2x660MW) project, the quantity of furniture to be supplied shall be twice of the furniture quantity that is mentioned under clause 6.05.00 a) to e), Part-A, Sub Section III-C of the specification. Bidder shall comply with the specification.<br>3) Bidder's understanding is correct. |
| 1530. | Section-VI, Part-A, Sub Section-III-C, Cl: 6.07.00 | 7 of 8 | Power Supply System- 24VDC and UPS | Owner may please clarify the following:1) As no specific requirement is indicated for power supply of RIO cabinets, it is proposed to extend the power supply from FGD control room | 1) Bidder to refer clause 9.01.00, PART-A Sub Section-IIIC, wherein it is mentioned that NTPC shall provide 2 (Two) nos. of 24V DC power supply feeders per unit from employer's DCDB, for |

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| | | | | to the nearby RIO cabinets. 2) Requisite Power supply feeder for Bidder's scope FGD OWS coming inside Owner's CCR shall be provided by Owner.Owner may please confirm concurrence | powering RIO panel located in CER. Cabling from DCDB to RIO panel (located in CER) shall be in bidder's scope of supply.2) It is clarified that NTPC shall provide 02 nos. of UPS power feeder per unit from employer's ACDB, for powering FGD OWS located in CCR. Cabling from ACDB to FGD OWS (located in CCR) shall be in bidder's scope of supply. |
| 1531. | Section-VI, Part-A, Sub Section-III-C, Cl: 9.02.00<br>&<br>Section-VI, Part-B, III-C1, Basic design Criteria, Cl: 3.05.01 | 8 of 8<br>&<br>3 of 4 | It is also envisaged to control, operate and monitor FGD and associated system remotely from main plant CCR trough ethernet link following TCP/IP standard.<br>&<br>Further, flue gas desulphurization system, link shall be provided for collection of data in DDCMIS (in Employer's Scope) | As separate FGD OWS is envisaged in CCR, it is understood that communication link from bidder FGD control system to Employer's DDCMIS is to be provided only for monitoring of FGD system through Owner DDCMIS, i.e. no control/ operation from Owner's DDCMIS.<br><br>Owner may please confirm. | Bidder's understanding is correct.<br>Bidder to refer clause 9.02.00, PART-A, Sub Section IIIC wherein it is mentioned that it is also envisaged to control, operate and monitor FGD and associated system remotely from main plant Central Control Room (CCR). To achieve the above the Contractor shall provide the following:<br>1) The FGD plant operation shall be made available through Ethernet link following TCP/IP standard. The system shall be OPC compliant.<br>Bidder shall comply with the above specification requirement.<br>It is further clarified that to achieve the above FGD OWS shall be located in respective unit (s) CCR. Refer amended |

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| | | | | | tender drawing 0000-151-POI-A-013 in this regard. |
| 1532. | Section-VI, Part-A, Sub Section-VII | | Mandatory Spares | Mandatory spares for Control and instrumentation are indicated under various mechanical packages (at Cl: 1.19.00, 1.21.00, 1.22.00, 1.23.00, 1.24.00) and then again at Cl: 1.25.00 and hence causing repetition of same spares at different clauses.<br>In view of the same, it is proposed to provide mandatory spares for all supplied C&I items in line with Cl: 1.25.00 only to avoid confusion.<br>Owner may please confirm. | Refer amendment in this regard. |
| 1533. | Section-VI, Part-A, Sub Section-III-A2, Cl: 2.00.00 g) | 2 of 4 | Contractor shall provide microprocessor/ PLC/ GIU based control system for control and monitoring of ventilation system as per manufacturer's standard practice. | Bidder proposes to provide relay based control system for ventilation system in line with standard and proven practice of OEM.<br>Owner may please confirm. | The bidder's proposal is not acceptable. Bidder shall comply with Technical specification requirements. |

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| 1534. | Section-VI, Part-A, Sub Section-III-A6 | 1 to 3 of 3 | General | As no requirement for control system is specified, it is proposed to provide integral control system for ZLD in line with OEM standard and proven practice. Further, separate OWS of ZLD inside FGD control room shall be provided with serial interface with FGD PLC system for monitoring of ZLD system .Owner to confirm concurrence. | Bidder's understanding is not correct. Bidder to refer clause 1.00.00 a), PART-A Sub Section IIIC wherein it is mentioned that the Contractor shall provide Independent Control & Instrumentation system for control, monitoring and operation of associated drives and auxiliaries in FGD system including Limestone grinding & handling system, Gypsum Dewatering & handling system, Zero liquid discharge system (ZLD) (if provided) and other systems being provided under the contract, in all regimes of operation in safe and most efficient manner. |
| 1535. | Section-VI, Part-B, III-C1, Basic design Criteria, Cl: 3.04.00 | 3 of 4 | .....In any case, Bidder shall be required to ensure the supply of spare parts for lifetime if the plant..... | With respect to control & instrumentation, the bidder shall support supply of spare parts for a period of 15 years, in view of the fast changing technology in the field of C&I.<br><br>Owner may please confirm. | With reference to clause 3.04.00, Part-B, Sub Section III-C1 of technical specification, it is clarified that lifetime of the plant is envisaged as 15 years for which bidder shall ensure supply of the spare parts. Bidder shall comply with the specification. |
| 1536. | Section-VI, Part-B, III-C2, Measuring Instruments, Cl: 10.00.00, S.No-8 | 19 of 34<br>&<br>23 of 34 | Under Common requirements for analyser Instruments, it is specified that calibration from Remote is required. | Bidder clarifies that the Auto & Manual calibration from local is envisaged for bidder supplied analzers.<br>Owner may please confirm. | Bidder's understanding is not correct. Specification requirement are clear. Bidder shall comply with the specification requirement. |

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| | &<br>Cl: 11.01.00, S.No-8 | | | | |
| 1537. | Section-VI, Part-B, III-C5, PLC Based Control System, Cl: 9.02.01 | 18 of 27 | Racks for Batteries of PLC system | As no specification is provided for battery racks, It is proposed to provide batterry rack in 2 step/ 2 tier configuration in line with standard practice for Ni-Cd batteries being followed in all major utilities.<br>Owner may please confirm concurrence. | Bidder's proposal is acceptable. |
| 1538. | Section-VI, Part-B, III-C5, PLC Based Control System, Cl: 16.00.00 | 26 & 27 of 27 | Annual Maintenance Contract for PLC | As AMC for PLC is not incdicated in Part-A, it is presumed that the same is not in the scope of Bidder. Owner may please confirm.<br>However, in case AMC for PLC is to be included in his scope by the bidder, then Owner may please claify the scope of services to be provided by bidder during "hardware support" period. | Bidder's understanding is not correct. It is clarified that AMC for PLC is in the scope of Bidder. Bidder to refer amendment in this regard. |

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| S.No | Clause No | Page No. | Description of Bid Document | Bidders Queries/Suggestions | NTPC Clarifications |
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| 1539. | Section-VI, Part-E, Drawing no: 0011-109-POMI-A-001 and 001 (a) | 1 of 1 | Typical scheme for blower and slurry re-circulation pumps | From the tender drawing, following is understood:1. Vibration Transmitters (2 nos i.e. one in X and one in Y direction) are to be provided at drive end of HT motor and Fan/ Pump only, i.e. 4 nos. transmitters per HT drive/ motor combination.2. Temperature Element is to be provided at drive end of motor and Fan/ Pump only. Due to space constraint only, one no. duplex element is proposed per bearing, i.e. total two nos. Duplex Temperature elements per HT drive/ motor combination. Owner may please confirm. | It is clarified that in the tender P&ID minimum quantity of field instruments to be supplied by the contractor, is indicated. However, bidder to also refer the relevant clauses of specification for the quantity of vibration transmitters and Temperature elements for motor and Fan/pump. |
| 1540. | Section-VI, Part-E, Drawing no: 0011-109-POMI-A-001 and 001 (a) | 1 of 1 | P&ID for FGD- Absorber System | Requirement of Flow indicator (local indication) at absorber Inlet and outlet duct as per tender P&ID is proposed to be met with local display in electronic transmitter provided for flow measurement.<br>Owner may please confirm concurrence. | Bidder's proposal is also acceptable. |
| ELECTRICAL | | | | | |

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| S.No | Clause No | Page No. | Description of Bid Document | Bidders Queries/Suggestions | NTPC Clarifications |
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| 1541. | Part- B-II Elect 1 clause no 2.01.01 Technical requirement | 3 of 7 | Adequate number of Auxiliary transformer shall be provided to meet the demand on 11KV, 3.3 KV and 415V system under most onerous conditions, with the criteria that each 11KV/3.3KV/415V switchgear /MCC/DB shall be fed by 2x100% or 3x50%, 3x100% transformer / feeders and these shall be rated to carry the maximum load expected to be imposed. | M/s NTPC is requested to furnish the criteria for selection of 3x100% Transformer /feeder arrangement. | 3X100% Transformers Shall not be required in any area. Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |
| 1542. | Drawing no 0011-109-POE-J-001/A-E Single line diagram | | 11 KV Switchgear | M/s NTPC is requested to confirm whether 11KV Tie Switchgear is same as 11 KV FGD Switchgear. | Confirmed. |
| 1543. | Drawing no 0011-109-POE-J-001/A-E Single line diagram | | Exsisting CHP/AHP system | Please specify the number and ratings of the exsisting CHP/AHP Transformers and its distance from the 11KV FGD Swichgear room. | Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |
| 1544. | Part- B-II Elect 1 1.11.00 Technical requirement | 2 of 7 | In fire hazardeous areas like gas/liquid fuel storage/handling areas lighting fixtures, switchgears shall be flame proof | The Switchgear for the Areas being referred to , are normally located in a separate Room , hence non flame proof switchgear can be proposed .M/s NTPC to confirm acceptance. | Equipment located in fire hazardous are shall be flame proof. In case switchgear located in non-hazardous are need not be flame proof. |
| 1545. | Part- B-II Elect 1 clause no 2.01.01 Technical re- | 4 of 7 | All ACDBs ,DCDBs,Solenoid Valve DBs and MCC on travelling trippers shall be fixed module type. All 415 V Circuit breaker modules and other MCC modules shall be | We understand from the Bid Clause that All ACDBs ,DCDBs,Solenoid Valve DBs shall be fixed type.M/s NTPC to confirm . | Confirmed. |

| S.No | Clause No | Page No. | Description of Bid Document | Bidders Queries/Suggestions | NTPC Clarifications |
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| | quirement | | fully draw out type. | | |
| 1546. | Part- B-II Elect 1clause no 2.04.00Technical requirement | 4 of 7 | All MV & LV circuit breakers shall be provided with Communicable Numerical Relays----.These relays shall be integrated with Employers Switchgear SCADA through Ethernet switches ( to be supplied by Employer ) mounted on each switchgear. | 1 )It is again requested to reconfirm following as per technical specifications :i. All the 11 KV/3.3KV & LT Incomers , Ties, Bus couplers , Transformer feeders shall be controlled from Switchgear SCADA and also from DDCMIS.ii. The Switchgear SCADA shall be supplied by Employer 2 ) M/s NTPC is requested to provide the Location of Switchgear SCADA . 3) M/s NTPC to confirm the scope of cabling between Ethernet Switches & SCADA. | This clause is deleted.<br>Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |
| 1547. | Part- B-II Elect 1 clause no 7.00.00 Technical requirement | 7of 7 | Equipment through Fault withstand capabilities under worst operating conditions duly taking into account negative tolerances on transformer and maximum fault levels of source etc. shall be as follows----------. | M/s NTPC It is requested to provide the through fault with stand capabilities criteria for incoming cables to 11/0.433 KV Switchgear. | Please refer Technical Specifications. |

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| 1548. | Part- B-II Elect 2 clause no 2.01.05 & 3.02.05 Technical requirement | 2 & 5 | The Cable vault / Cable spreader room space below the HT/LT switchgear room, control room, Unit control equipment----------. Cable Trenches shall be provided only in Swicthgear/MCC rooms | It is proposed to provide cable trenches as per cl no 3.02.05 in Switchgear room. No Cable vault / Cable spreader is considered for Switchgear room.M/s NTPC to confirm acceptance. | Bidder to provide the same as per their standard pratice complying with technical specification |
| 1549. | Part- B-II Elect 1 clause no 7.00.09 Technical requirement | 4 | SIC termination kit shall be suitable for fault level of 25KA for 0.17 sec | It is requested to reconfirm the fault level for Termination Kit. | Confirmed. |
| 1550. | Part- A Elect 1 Subsection-IIIB Electrical System/Equipment clause no 1.08.00 Technical requirement | 2 of 6 | Contractor scope shall include laying of cable from employer board ---- on the employers nearest trestle in the FGD Area subject to availability of space & suitability. In case of non availability of space in employer trestle , contractor shall make necessary arrangement for cable tray erection & cable laying | Due to space constraint ,It is not feasible to construct a new trestle from Main Plant Area for FGD System cabling. Hence existing Trestle shall have to be utilized for cabling to FGD Switchgear from Main plant. M/s NTPC is requested to undertake the exercise to create the space in existing trestle for FGD cabling . | Bidder shall comply with technical specification CL no:- 1.08.00.2. In case of non availability of space in employers trestle, bidder shall make necessary arrangements for cable tray erectiona and laying. However bidder may visit the project in order o get itself acquainted with existing electrical of plant. |
| CIVIL | | | | | |
| 1551. | SUB SECTION-II-A10-PROJECT INFORMATION-BARH-I 3X660 MW | 30 | List of Drawings, Sl No-2(Topographical Survey Drawing) & Sl. No-3(Equipment Layout Plan) are missing. | NTPC to submit the soft copies(Autocad drawing) of missing drawings. | Owner provide's PDF file only. |

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| 1552. | SUB-SECTION-II-A8 PROJECT IN-FORMATION-NABINAGAR-I 3X660 MW | - | Topographical survey drawing is missing | NTPC to submit the soft cop-ies(Autocad drawing) of topographical survey drawings. | Owner provide's PDF file only. |
| 1553. | SUB-SECTION-II-A8PROJECT IN-FORMATION-NABINAGAR-I 3X660 MW_Clause No:6.00.00 | 9 | SITE SPECIFIC DESIGN PARAMETERS: The various design parameters, as defined in IS: 875 (Part-3), to be adopted forthe pro-ject site shall be as follows:<br>a) The basic wind speed “Vb” at ten | NTPC to furnish basic wind speed "Vb" at 10m height above the mean ground level. | The basic wind speed "Vb" at 10m height above the mean ground level for "NABINAGAR-I 3X660 MW" project shall be 47 metres/second. Also refer Amendment issued separately in this regard. |
| 1554. | SUB-SECTION-II-A8 PROJECT IN-FORMATION-NABINAGAR-I 3X660 MW_Clause No:7.08.00_SR-g_Item No-2 | 21 | 2) In view of the above, the following shall be adopted for all foundations and sub-structures, | Item description is incomplete. | Query is not clear. |

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| 1555. | SUB-SECTION-II-A3,A4,A6,A7 & A11 PROJECT IN-FORMATION- | - | Bore log details for following projects are missing,<br>1. Solapur STPP, Stage-II (2x660MW), 2. Gadarwara STPP, Stage-I (2x800MW), 3.Nabinagar TPP (4X250 MW), 4. DAR-LIPALLI STPP, Stage-I (2X800 MW), 5. Tanda STPP, Stage-II (2x660MW) | NTPC to furnish the borelog details of missing project. | For Borelog details, bidder may refer Project information chapter furnished in Technical Specification for Gadarwara STPP, Nabinagar TPP and Tanda STPP. Further, Bidder may also refer amend-ment no.1 for Darlipalli STPP, Meja and Soalpur STPP. |
| 1556. | SECTON -VI TECHNICAL SPECIFICATION, Clause: 4.02.00 | 18 | The scope for foul water from toilets shall include layout and laying of sewers up to the Employer's main sewer line for sew-erage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and in-spection chambers within the building and from the building to the Employer's sewer line. | NTPC to furnish the exisitng Sewer layout drawing. | Drawing shall be provided after award of work. |

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| 1557. | SECTON -VI TECHNICAL SPECIFICATION, Clause: 4.02.00, Clause: 21.00.00, Clause: 15.00.00 | 29,41,32 | Clause: 4.02.00-For sewerage below ground stoneware pipes conforming to 18: 651 with concrete bedding and haunch. Clause: 21.00.00-Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD area to the nearest available manhole of the owner. Clause: 15.00.00-Cement concrete pipes of class NP-3 as per 18:458 shall be used below ground level for sewage disposal in all areas. | NTPC to confirm the type of pipe to be used for sewage disposal. | Refer amendment issued separately. |
| 1558. | SECTON -VITECHNICAL SPECIFICATION, Clause: 12.00.00 | 30 | Specification pertaing to road shoul-der(shoulder width, subgrade materials used and their thickness) is missing. | NTPC to furnish the shoulder specifi-cation. | Refer amendment issued separately. |
| 1559. | SECTON -VI TECHNICAL SPECIFICATION, Clause: 15.00.00 | 32 | Sewage pump house shall be provided as per IS:4111. | NTPC to furnish the sewage pump house specification. | Refer amendment issued separately. |

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| 1560. | PART-E | drawing no.0011-109-POE-J-001/A-E | 53 | CHP/AHP HT switchgear shall then inturn be fed from 11kV tie switchgear. | Please provide the total loads of 11 kV AHP/CHP SWGR. And whether all AHP/CHP SWGR of 11 projects need feeders shall be two? Especially 3 boilers and 4 boilers<br><br>Please fill in data sheet 1 | Details for feeders proposed to be used for FGD system have included in AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |
| 1561. | PART-E | drawing no.0011-109-POE-J-001/A-E | 53 | | Please clarify that the 11/0.433 kV transformers of the FGD whether shall be used dry type instead of oil immersed type. | Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |
| 1562. | PART-E | drawing no.0011-109-POE-J-001/A-E | 53 | | Please clarify that whether all projects shall be provided two number 11kV motor like the booster fan per unit from existing spare feeders in station boards. | Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |
| 1563. | PART-B-II-ELECT-3 | SUB-SECTION-II-E10 LT SWTIGCHGEAR & LT BUSDUCT 32.00.00 lighting/welding transformers | 32 | Each AC Lighting Distribution Board (LDB) shall be fed from 415V / 415V, 50kVA(minimum) isolating transformer & Each Welding Distribution Board (LDB) shall be fed from 415V /415V, 100kVA isolating transformer. The lighting / welding transformer may, preferably, be located inside the LDB / Welding DB panel itself. | Please clarify that whether the lighting/welding transformers could be canceled in FGD area, , considered the lighting and welding loads,there is no need to set the separate lighting/welding transformers. The power of the lighting DBs and Welding DBs can be provided by the PC/MCC nearby. | Bidders to follow Technical Specifications. |

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| 1564. | PART-E | Part A sub-section I intent of specification | 6 | note: all the above drawings are indicative of employer's requirements to enable the bidder to make a suitable offer..... | Please clarify whether or not can we choose the electrical single line scheme case by case, or we can only obey the reference FGD electrical single line diagram for all the case. According to the electrical loads, the reference single line diagram is not the most reasonable or economic scheme. | Please refer AMENDMENT NO TO TECHNICAL SPECIFICATION (SECTION VI). |
| 1565. | PART-B-II-ELECT-3 | SUB-SECTION-II-E11 DIESEL GENERATORS 4.05.00 | | The DG Set shall be located inside the acoustic enclosure and kept outdoors. | The DG Set shall be located inside the acoustic enclosure and kept indoors. | Technical Specifiactions are clear. Bidder shall comply with technical specification requirements. |
| 1566. | PART-B-II-ELECT-3 | SUB SECTION-II-E9 HT SWITCHGEAR 1.00.00 DESIGN CRITERIA FOR MV SWITCHGEARS | 2 | all MV Switchboards is provided with one spare motor feeder and one transformer feeder on each section for future requirements. | please provide the total loads of the 11kV spare feeders. | This clause is deleted. Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI). |
| **1567.** | **I&C** | | | | | |

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| 1568. | | | | | Please clarify the quantities of Operator Work Station(OWS), Engineering Work Station(EWS) and the Historical Storage & Retrieval Station(HSRS) for FGD control and operation per unit, including those furnished in FGD control room and in main plant CCR | Bidder's understanding is correct. Amendment will be issued in this regard. |
| 1569. | | | | | FGD-PLC system shall be time synchronized with master clock system.<br>Please provide the interface of the owner's master clock system with FGD-PLC. | Different station has different master clock system. Accordingly, the interface requirement shall be discussed and finalised with respective successful bidders during detail engg. |
| 1570. | PART-A,SUB-SECTION-III-C (C&I) | 2.02.00 | 2/8 | Single Input DIN rail mounting type temp transmitters (mounted in JBs) shall be provided by the Contractor for all temperature elements under Contractor's scope. | Please clarify whether Resistance Temperature Detector shall be hardwired up to RTD input module of FGD-PLC instead of temperature transmitter as per the standard and proven practice of the Contractor. If not, please clarify whether temperature transmitters can be centralized in PLC cabinets other than local arrangement. | Bidder to follow specification requirement. |
| 1571. | | | | | Please clarify whether FGD OWS in main plant CCR be of remote communication type, linked via redundant OFCs from FGD-PLC network. | OWS in main plant CCR will be of the same configuration with respect to hardware, OS, application software and license as that of the OWS in FGD control room. Further bidder to refer to clause no. 9.02.00 |

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| | | | | | | of Sub Section-III-C of Part A of specification. |
| 1572. | | | | | | |
| **1573.** | **CIVIL** | | | | | |
| 1574. | PART B | | | | Please clarify the tender GLP drawlings cover all exiting buildings and sturctures in the planning space. | Bidder to refer the amended GLP. |
| 1575. | PART B | | | | Are there some exiting buildings and sturctures in the planning space for FGD needed to be removed? If there were, was the removement work under the Contractor's scope, or under the Owner's scope? | |
| 1576. | PART B | | | | When the planning space for FGD is not enogh, if the contractor could chose another fit and spare space for FGD. | Bidder to refer the revised GLP in issued amendments. |
| 1577. | PART B | | | | Please provide groundwater annual water level elevation and quality of groudwater, and its corrosion possibility to concrete and steel undergraound. | Bidder to refer the revised GLP in issued amendments. |
| 1578. | MEJA-II-A9-2 Meja GLP | | | | Please provide the planning space for FGD. | Query is not clear. |
| 1579. | DARLIPALLI-II-A4-1 PROJECT INFOR- | | | | Please provide BORE LOG in or adjacent to the planning space for FGD. | Bidder to refer necessary amendment. |

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| | MATION | | | | | |
| 1580. | SOLAPUR-II-A6-1 PROJECT INFOR-MATION | | | | Please provide BORE LOG in or adjacent to the planning space for FGD. | Bidder to refer necessary amendment. |
| 1581. | PART B | | | | Please clarify the structures types of all kinds of sturcture for FGD | Type of Building structure (RCC/ Steel), if not specified in the technical Specification shall be decided by the bidder considering the functional requirement, schedule of construction and site con-straints ( if any). |
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| | | | | | | |

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| | **FGD SYSTEMS** | | | | | |
| 1582. | Section-VI<br>Part-A<br>Sub Sec-I / Intent of Specification | 3.00.00 | 4 of 19 | The scope and terminal points of the equipment to be furnished under this steam generator package shall be as identified in these drawings and read in conjunction with text of the specification | "Steam Generator Package" mentioned in the clause is considered as typo and it shall be replaced with "FGD System Package". NTPC to confirm. | “Steam Generator Package" should be read as “Flue Gas Desulphurisation System Package” |

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| | **FGD SYSTEMS** | | | | | |
| 1583. | Section-VI<br>Part-A<br>Sub Sec-V / Salient Design Data & Sizing | 1.00.00 (7) | 1 of 26 | **The Flue Gas Desulphurisation (FGD) System for Kudgi-I 3X800 MW, Lara-I 2X800 MW, Gadarwara-I 2X800 MW & Darlipalli-I 2X800 MW...**<br>Flue Gas Composition at FGD system inlet at Design Point:<br>(i) $O_2$ (% v/v wet) : 6.115<br>(ii) $CO_2$ (% v/v wet) : 10.501<br>(iii) $H_2O$ (% v/v wet): 3.958<br>(iv) $SO_2$ (% v/v wet): 0.065<br>(v) $N_2$ (% v/v wet) : 69.362 | Summation of flue gas composition is not equal to 100. It is presumed $H_2O$ (% v/v wet) is13.957 instead of 3.958. NTPC to confirm. | Refer necessary amendment in this regard. |
| 1584. | Section-VI<br>Part-A<br>Sub Sec-V / Salient Design Data & Sizing | 2.00.00 | 3 of 26 | The Flue Gas Desulphurisation (FGD) System for Mouda-II 2X660 MW,<br>Tanda-II 2X660 MW, Nabinagar-I 3X660 MW, Meja-I 2X660 MW & Barh-I 3X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point'.. | Since, Meja-I 2 x 660 MW is mentioned in both the clauses of Salient Design Data, NTPC to clarify the design data to be considered for this plant. | Refer necessary amendment in this regard. |

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| | **FGD SYSTEMS** | | | | | |
| | | 3.00.00 | 5 of 26 | The Flue Gas Desulphurisation (FGD) System for Solapur-II 2X660 MW & Meja-I 2X660 MW shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point'.. | | Refer necessary amendment in this regard. |
| 1585. | Section-VI Part-A Sub Sec-V / Salient Design Data & Sizing | 1.00.00 / 2.00.00 / 3.00.00 / 4.00.00 | 1, 3 ,5 & 7 of 26 | The Flue Gas Desulphurisation (FGD) System ... shall be designed to comply with the requirements stipulated under 'Guarantee point and Design point' in the table.. | NTPC is requested to furnish the flue gas data at FGD inlet for various loads ( including minimum load point of steam Generator) and Coal. | Data will be furnished during detail engg stage. |
| | Section-VI Part-B Sub Sec-I-M1 (FGD) | 1.03.06 | 3 of 51 | The FGD and the ancillary facilities shall be suitable for unlimited operation with all transients and **at any load point between the minimum and maximum load point of the Steam Generator.** Further, the FGD plant shall be suitable for an unlimited operation at any pollutant concentrations between minimum and maximum without exceeding the emission val- | | |

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| | **FGD SYSTEMS** | | | | | |
| | | | | ues of SO2 emission of less than 100 mg/Nm3 (6% O2 dry). | | |
| 1586. | Section-VI Part-A Sub Sec-V / Salient Design Data & Sizing | 1.00.00 (5) / 2.00.00 (5) / 3.00.00 (5) / 4.00.00 (5) | 1, 3 ,5 & 7 of 26 | Gas flow at the FGD inlet when firing respective coal in $m^3/s$ | NTPC to clarify the pressure (including site altitude correction) considered for the FGD inlet flue gas provided in m3/s for 800 MW & 660 MW units. Also, It is presumed that no other site specific correction need to be applied on the specified flue gas flow. NTPC to confirm. | No altitude correction is to be applied on the flue gas flow indicated in the referred clauses. |
| 1587. | Section-VI Part-A Sub Sec-V / Salient Design Data & Sizing | 6.00.00 | 10 of 26 | **Limestone Characteristics:** Bond Index : 13 kWh/t | Bidder considered Limestone bond index as 13 kWh/t inline with Section-VI Part-A, Sub Sec-V / Salient Design Data & Sizing / Clause No. 6.00.00 / P.No: 10 of 26. Also, it is presumed that kWh/t corresponds to kWh/MT. NTPC to confirm. | Limestone Bond Index : 13 kWh/Sh.T (Min.) should be followed. Refer necessary amendment. |
| | Section-VI Part-B Sub Sec-I-M1 (FGD) | 6.05.01 (vi) | 23 of 51 | Limestone Bond Index : 13 kWh/Sh.T (Min.) | | |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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| | **FGD SYSTEMS** | | | | | |
| 1588. | Section-VI<br>Part-A<br>Sub Sec-VI / Functional Guarantees & Liquidated Damages | 4.02.00 (vi) | 18 of 24 | **Waste Water:**<br>The Contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10m3/hr averaged over a 24 hour period from each unit. | It is presumed that waste water purge flow rate limit of 10 $m^3$/hr (averaged over a 24 hour period) is applicable for each FGD unit of the plants having 660 MW & 800 MW units. For Nabinagar plant with 250 MW units, the purge flow rate limit for each FGD unit is considered as 5 $m^3$/hr (averaged over a 24 hour period). NTPC to confirm. | Refer necessary amendment in this regard. |
| | Section-VI<br>Part-A<br>Sub Sec-VI / Functional Guarantees & Liquidated Damages | 4.02.00 (xvii) | 20 of 24 | **Waste Water Treatment System (Applicable for Barh-I 3X660 MW & Nabinagar 4x250 MW:**<br>The Contractor shall guarantee the followings.<br>A) Wastewater treatment capacity(m3/hr) : ≥ 30 for Barh-I (3X660 MW)<br>B) Wastewater treatment capacity(m3/hr) : ≥ 20 for Nabinagar (4x250 MW) | | |
| 1589. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 3.03.09 | 7 of 51 | Provision shall be made for giving signal automatic bypass controls of the absorber in case of failure of the absorber spray system or the GGH. | Since GGH is not applicable for this project, the related tender requirements have been ignored. NTPC to confirm. | Bidders understanding is correct. GGH is not applicable for this package. |

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| | **FGD SYSTEMS** | | | | | |
| | Section-VI<br>Part-B<br>Sub Sec-I-M7<br>Zero Liquid Discharge System | 3.01.00 | 3 of 32 | The wastewater stream will be made up of reject water from FGD, GGH washing<br>etc. | | |
| | Section-VI<br>Part-B<br>Sub Sec-I-M7<br>Zero Liquid Discharge System | 3.01.00 / B(3) | 5 of 32 | FGD Wastewater such as GGH washing water and filtrated water which is bled to control chloride concentration in FGD system shall be routed to Preclarifier(s). | | |
| | Section-VI<br>Part-B<br>Sub Sec-I-M7<br>Zero Liquid Discharge System | 3.01.00 / C(1) | 7 of 32 | FGD wastewater tanks(2x50%) shall designed to store FGD wastewater from all units of FGD system operated continuously for 24 hours and GGH washing water which is produced temporarily. | | |
| | Section-VI<br>Part-B<br>Sub Sec-I-M9<br>MDL | MDL - S.No: 7,8,79,83,92,93,140,163, 167,244,246,247,259,340,392,429, 443,453,49 | | GGH Details | | GGH Details will not be applicable. |

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| | **FGD SYSTEMS** | | | | | |
| | | 9,585,620. | | | | |
| 1590. | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 1.03.00 | 1 of 9 | The contractor shall also supply an auxiliary absorbent tank, common for the two units, for storage of absorber slurry of one unit. | One No. of Auxiliary Absorbent tank will be provided common for all the units of each plant and the tank will be suitable for storage of absorber slurry of one unit. Also, "employer" mentioned in the Section-VI Part-A Sub Sec-III-A1 FGD/ Clause No. 6.01.00/ P.No:5 of 9, is considered as typo and it shall be replaced with "contractor". NTPC to confirm. | Bidders understanding is correct. Refer necessary amendment in this regard. |
| | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 6.01.00 | 5 of 9 | The employer shall provide a common auxiliary absorbent tank, common for all the units, of sufficient capacity for storage of absorber slurry of one unit. | | |
| 1591. | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 2.04.00 | 2 of 9 | The contractor shall terminate the flue gas duct (at a suitable point on the common flue gas duct to chimney upstream of the chimney terminal point and outside the chimney). | Inline with tender requirement, a new wet chimney is proposed for all the projects and the absorber outlet flue gas duct will be terminated upstream of this chimney. Hence, the flue gas | Refer necessary amendment in this regard. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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| | **FGD SYSTEMS** | | | | | |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 3.02.04 | 6 of 51 | The duct from Absorber outlet to bypass duct shall be made of Carbon steel of minimum 7mm thickness with 2 mm (minimum) thickness lining / cladding / wall paper of Alloy C276 / Alloy 59 or better material. | duct from outlet of the absorber to common flue gas duct (bypass duct) to chimney is not considered. NTPC to confirm. | |
| 1592. | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 2.06.00 | 2 of 9 | Washed and dewatered gypsum from the dewatering system shall be fed to a belt conveyor (in Employers scope). The contractor shall discharge the gypsum cake above the Gypsum handling belt conveyor being provided by the Employer. | Bidder presume that belt conveyor shall be in the "contractor" scope instead of "employer" scope. NTPC to confirm. | Bidders understanding is correct. Refer necessary amendment in this regard |
| 1593. | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 6.02.00 | 5 of 9 | **Auxiliary Absorbent Tank:**<br>The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.). | Both the requirements are contradictory, hence 1x100% slurry pump per station is considered to pump back the slurry from the absorbent tank to the absorber. | Bidders understanding is correct. Refer necessary amendment in this regard |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 7.08.02 | 29 of 51 | **Auxiliary Absorbent Tank:**<br>The contractor shall provide 2 x100% pump to pump back the slurry from the sump back to the absorber in a maximum | | |

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| | **FGD SYSTEMS** | | | | | |
| | | | | time of 8 hours. | | |
| 1594. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 5.06.23<br>7.08.01 | 20 of 51<br>29 of 51 | It should be possible to discharge the absorber sump into the emergency drain tank within 2 hours. | Bidder presume that emergency drain tank mentioned in this clause refers to auxiliary absorbent tank. NTPC to confirm. | Bidders understanding is correct. |
| 1595. | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 7.00.00 | 5 of 9 | Process Water & Cooling Water Storage & Pumping Scheme (For 2X800 MW) | It is presumed that "Process Water & Cooling Water Storage & Pumping Scheme" is applicable for all units. NTPC to confirm. | Bidders understanding is correct. |
| 1596. | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 7.08.00 | 6 of 9 | **Process Water Tanks:**<br>All the storage tanks shall be lined with vinyl ester based flake glass lining from inside. | NTPC to clarify the type of lining to be considered for process water tanks. | Interior surface of the tanks shall lined with replicable chlorobuty/bromobutyl rubber lining of minimum 4 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness. |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 13.03.07 | 34 of 51 | **Process Water Tanks:**<br>Interior surface of the tanks shall lined with replicable chlorobuty/bromobutyl rubber lining of minimum 4 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness... | | |

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| | **FGD SYSTEMS** | | | | | |
| 1597. | Section-VI<br>Part-A<br>Sub Sec-V / Salient Design Data & Sizing | 9.01.00/ a (6) | 21 of 26 | **Noise Level for Air Compressor:** Noise level shall not exceed 90 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level. | Noise levels for below auxiliaries are as follows:<br><br>1.Limestone ball mill: ≤ 90 dB(A) with barrier.<br>2.Crusher: ≤ 105 dB(A)<br><br>NTPC to confirm | Bidder to refer necessary amendment in this regard. |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 1.09.00 | 4 of 51 | **Noise Level:** The equivalent weighted average of sound level measured at a distance of 1.5 m above floor level in each elevation and one meter horizontally from the base of any equipments furnished and installed under these specifications, expressed in decibel to a reference of 0.0002 microbar, shall not exceed 85 dB(A). | | |

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| | **FGD SYSTEMS** | | | | | |
| | Section-VI<br>Part-C<br>General Technical Requirements | 30.00.00 | 42 of 83 | **Noise Level:**<br>The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA . However for Ball Mills the noise levels as per following shall also be acceptable:<br>a) Ball Mill < 90 dBA | | Bidder to refer necessary amendment in this regard. |
| 1598. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 7.06.02 | 27 of 51 | 2x100% horizontal centrifugal pumps shall be provided for wash water requirements of belt filter. | Wash water for the belt filter should be clean water and not filtrate. The source of wash water should be the clarified | Bidder shall comply with the specification requirements. |

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| | **FGD SYSTEMS** | | | | | |
| | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 5.04.00 | 5 of 9 | The filtrate water from belt filter dewatering and wash water from washing system<br>and the under flow from the secondary hydro-cyclone shall be taken to a common filtrate water tank.2x100% pump shall be provided to supply wash water (for cake washing as well as belt cloth washing) to the belt filters. | water as stated in Section-VI,Sub-Section IV, Clause No-1.06.00,Page No- 2 of 3. Therefore 2x100% pumps for wash water (filtrate) are not envisaged. NTPC to confirm . | |
| | Section-VI<br>Part-A<br>Sub Sec-IV<br>Terminal Points & Exclusions | 1.06.00 | 2 of 3 | **Gypsum Wash Water (Clarified Water):**<br>For Gypsum washing, Contractor shall take a tap off suitably from the existing HVAC header (HVAC make up pump discharge) available along C-row at CD bay rack for meeting the water requirement of Gypsum washing. The pressure available at TP will be 4Ksc ( gauge) wrt FGL (approx.). | | |

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| | **FGD SYSTEMS** | | | | | |
| 1599. | Section-VI<br>Part-A<br>Sub Sec-IV<br>Terminal Points & Exclusions | 1.08.00 | 2 of 3 | **Waste Water:**<br>FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank and 300 mm above FFL in HCSD Silo Area. Pressure at terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be <50°C. | Normally temperature of waste water will be in the range of 50 to 60°C and no separate cooling system is considered for waste water. NTPC to confirm. | Noted. |
| 1600. | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 7.01.01 | 6 of 9 | 2x100% Process Water Pumps for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. | 2 x 100% Process water pumps shall be provided for each unit. NTPC to confirm. | Specification requirement is clear in this regard. |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 13.02.00 | 33 of 51 | 2x100% Process Water Pumps shall be provided for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation. Each pump catering to process water | | |

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| | **FGD SYSTEMS** | | | | | |
| | | | | requirement of one unit. The capacity of the pumps shall be such that it shall meet the maximum process water requirement of each unit.. | | |
| 1601. | Section-VI<br>Part-A<br>Sub Sec-III-A1<br>FGD | 7.02.00 | 6 of 9 | 2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 2x800 MW) along with all necessary piping, valves, control & instrumentation. Each pump catering to mist washing requirement of one unit. | 2 x 100% Mist Eliminator wash pumps shall be provided for each unit. NTPC to confirm. | Specification requirement is clear in this regard. |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 13.03.00 | 34 of 51 | 2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor. | | |

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| | **FGD SYSTEMS** | | | | | |
| 1602. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 1.03.08 | 3 of 51 | In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, flue gas damper upstream & downstream of FGD, Process water pump & lube oil system of Booster Fan & Ball Mill) which may cause irreversible damage to the FGD System shall be connected to the emergency power supply system to be provided by the Contractor. | Since, a new wet chimney is to be provided for the proposed FGD projects, flue gas damper downstream of FGD is not required and hence not envisaged. NTPC to confirm. | Bidders to Refer necessary amendment in this regard. |
| 1603. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 3.01.00 (1) | 5 of 51 | **The entire flue gas system, flue gas ducts, absorber etc. shall be designed to meet the following conditions:**<br>Design internal pressure at 67% yield strength (mmwc): +660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher | Bidder considered duct design pressure inline with Section-VI Part-B, Sub Sec-I-M1 (FGD) / Clause No. 3.01.00 (1) / P.No:5 of 51. NTPC to confirm. | Refer necessary amendment in this regard. |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 16.01.03 | 39 of 51 | **Duct Design Pressure:**<br>All flue gas ducts shall also be designed for ± 660 mm w.g., or | | |

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| | **FGD SYSTEMS** | | | | | |
| | | | | maximum conceivable pressure of the relevant fans, whichever is higher at 67% of yield strength of material | | |
| 1604. | Section-VI Part-B Sub Sec-I-M1 (FGD) | 3.01.00 (5) | 5 of 51 | Maximum flue gas velocity through the Absorber (M/sec) : Not more than 4 m/s at Design Point Conditions | Bidder presume that the specified flue gas velocity limit refers to "Superficial gas velocity". NTPC to confirm. | Specification requirement is clear under the referred cl.no. 3.01.00 (5) . Bidder to comply with the specification requirements. |
| 1605. | Section-VI Part-B Sub Sec-I-M1 (FGD) | 4.01.01 (1) | 8 of 51 | Type of fans : Constant speed, Axial type. | Since, centrifugal type ID fans are provided for Nabinagar (4x250 MW) plant as per the information provided in Sub Sec-II-A11 (Project Information - Nabinagar 4x250 MW) / Table-5 / P.No:28 of 29 of tender specification, NTPC to clarify whether Booster fan can also be provided as Centrifugal type instead of axial type. | Bidder shall comply with the specification requirements. |
| 1606. | Section-VI Part-B Sub Sec-I-M1 (FGD) | 4.01.00 | 8 of 51 | Additionally a pressure loss of 100 mm wcl (excluding margin) shall be built up in booster fan design criteria as mentioned below to take care of pressure loss due to future installation of | Since, additional pressure loss of 100 mmWc is to be considered on account of De-NOx system for booster fan sizing, NTPC to re-confirm the flue gas pressure at booster fan inlet. | Bidder shall comply with the specification requirements. |

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| | **FGD SYSTEMS** | | | | | |
| | | | | De-Nox system. | | |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 4.01.01 (3 - iii) | 9 of 51 | Pressure at Booster Fan suction : 0 mmWc | | |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 4.02.00 (vi) | 10 of 51 | Pressure at Booster Fan suction : 0 mmWc | | |
| 1607. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 5.01.00 (iii) | 14 of 51 | All slurry recirculation pumps including motors shall be of the same size and type. | The slurry recirculation pump motor size and type will be same. Gearbox speed ratio for each pump will be different depending upon the head requirement of each spray level. | Noted. |
| 1608. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 5.04.00 | 16 of 51 | **Gypsum Bleed Pump:**<br>The pumps shall be designed to meet the stipulations of Clause No.9.00.00 of this Sub-Section. | Clause No.9.00.00 of this Sub-Section indicated Vertical Sump Pumps. Bidder believe the reference shall be to Sub-Section 8.00.00 -Slurry Pumps. NTPC to confirm. | Bidders understanding is correct. |
| 1609. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 5.06.10 | 19 of 51 | The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as | The proposed design of absorber is having a sloped inlet flue gas duct along with an inlet eyebrow design which negates the need for any duct wash as | Bidder shall comply with the specification requirements for flushing system. |

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| | **FGD SYSTEMS** | | | | | |
| | | | | well as intermittently. | per the experience of QFGDM. So, duct wash & normal quench system is not required and hence not envisaged. | |
| | Section-VI Part-E | Scheme of FGD Absorber system | Drawing No: 0011-109-POM-A-001(a) - Rev.No:A | Normal Quench System with Quench Nozzles and Control valves | | Normal Quench System with Quench Nozzles and Control valves shall be provided if it is the standard practise of the bidder/its collaborator. |
| 1610. | Section-VI Part-B Sub Sec-I-M1 (FGD) | 5.06.13 | 19 of 51 | All internal members shall be lined with minimum 2 mm Alloy 59/ C276 . | NTPC to elaborate the definition of internal members i.e. whether these includes only structural members or all the components (Suction Strainers, baffles, Agitators, etc.) located inside the absorber. Also, NTPC to advise whether Polypropylene can be considered as the alternate MOC for Recycle pump suction screens. | All internal members of Absorber shall be lined with minimum 2 mm Alloy 59/ C276 unless material is specifically specified for any component. |
| | Section-VI Part-B Sub Sec-I-M1 (FGD) | 11.05.00 | 32 of 51 | The material for the shaft (which is continuously in contact with slurry) and agitator blades of the Absorber Agitators shall be made with Alloy 926 or better material. | | |
| | | 5.06.22 | 20 of 51 | In case of Spray Tower System, Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps. | | Regarding Suction screens refer necessary amendment in this regard |

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| | **FGD SYSTEMS** | | | | | |
| 1611. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 5.06.21 | 20 of 51 | The bottom of the absorber sump shall be designed in such a way that complete drainage of the absorption liquid/slurry is possible and is accessible without damage of lining/rubber. | It is presumed that rubber lining is not acceptable for absorber sump (oxidation tank). NTPC to confirm. | Bidders understanding is correct. Refer necessary amendment in this regard. |
| 1612. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 10.01.00 | 31 of 51 | **Slurry & Process Water Tanks:** Coarse screen(s) at suction-side of these pumps shall be provided. | Coarse screens are generally considered at the suction side for slurry recirculation pumps only. All other slurry pumps are handling fine slurry only. Hence coarse screens are not envisaged for other slurry pumps and also process water pumps. NTPC to confirm. | Bidder shall comply with the specification requirements. |
| 1613. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 6.03.05 | 22 of 51 | In addition, a hand wheel with proper access shall also be provided for manual operation of the gate. The force at the rim of the hand wheel shall not exceed 35 kg with bunker full of coal. | It is presumed that "coal" mentioned in this statement is a typo and it shall be replaced with "limestone". NTPC to confirm. | Bidders understanding is correct. Refer necessary amendment in this regard. |
| 1614. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 6.05.01 (ii) | 22 of 51 | Flow: 110% of limestone requirement of two absorbers at Design point | It is presumed that flow is to be considered as " 110% of limestone requirement of all units in operation at Design point". | Bidders understanding is correct. Refer necessary amendment in this regard. |

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| | **FGD SYSTEMS** | | | | | |
| | | | | | NTPC to confirm. | |
| 1615. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 6.06.01 | 24 of 51 | For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower. | NTPC to advise whether solid concentration (by weight) of 30% can be considered for tank volume calculation. | Bidder shall comply with the specification requirements at cl.no. 6.06.01. |
| 1616. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 6.07.03 | 24 of 51 | The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 10 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends. | Rubber lining thickness of 3 to 6 mm is sufficient for slurry piping. NTPC to confirm. | Refer necessary amendment in this regard. |
| 1617. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 7.04.01 (c) | 26 of 51 | Gypsum Purity : 90% (minimum) | Inline with Clause 4.02.00 (v), Sub-Section-VI, Section-VI, Part-A, it is presumed that the gypsum purity of 90% is to be maintained at guarantee point condition only. | Specification requirement is clear in this regard. Bidder to refer sub section-VI, Section VI part A for more details. |

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| | **FGD SYSTEMS** | | | | | |
| 1618. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 7.04.03 | 26 of 51 | The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design. | Parts in contact with Gypsum (like Gypsum discharge chute) will be of Carbon steel with rubber lining.However, since the complete frame of filter is not exposed to Gypsum, the unexposed part of the filter frame will be made of Mild steel with Epoxy paint (MSEP) as per Industry practice . NTPC to confirm. | Noted. |
| 1619. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 7.05.05 | 27 of 51 | The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application. | The liquid ring type vacuum pump doesn't require lining and hence the same is not considered. NTPC to confirm. | The material selected for vacuum pumps & vacuum receivers shall be proven for similar application and shall be subjected to approval of the Employer. |
| 1620. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 10.01.00 | 31 of 51 | All the slurry tanks (Slurry Tanks, Filtrate Tank, Secondary hydro cyclone feed tank, vacuum receiver tank, Waste water Tank, Lime Neutralization tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest | IS 803 is considered for slurry tank design.This code also specifies hazard requirements related to storage of oil, which are not applicable for storage of limestone slurry. In view of this, hazard requirements for oil in IS 803 are not considered | Noted. |

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| | **FGD SYSTEMS** | | | | | |
| | | | | edition. | for limestone slurry tank. | |
| 1621. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 13.01.00 | 33 of 51 | **Process Water Storage Tanks:**<br>All the process water storage tanks shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the bidder. | For all the Process water tanks, additional corrosion allowance of 1.50 mm is considered on the minimum tank shell thickness as calculated by IS:803. NTPC to confirm. | Bidder to refer necessary amendment in this regard. |
| | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 13.03.07 | 34 of 51 | All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. | | |

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| | **FGD SYSTEMS** | | | | | |
| 1622. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 14.17.00 | 36 of 51 | **Approach and Handling Facilities:**<br>Inter-connecting pipes/cables between various facilities of FGD plant shall be routed on the steel trestles to be provided by the contractor. | Since limestone slurry and Gypsum Bleed Slurry piping length is more in all the projects with site specific layout constraints, NTPC to advise whether existing pipe rack can be used instead of separate pipe rack. | Bidder shall comply with the specification requirement. |
| 1623. | Section-VI<br>Part-C<br>General Technical Requirements | | 75 of 83 | Public Address System | It is presumed that public address system is not in bidder's scope of supply. NTPC to confirm. | Public Address System is not in the scope of the bidder. |
| 1624. | Section-VI<br>Part-A<br>Sub Sec-IV<br>Terminal Points & Exclusions | 1.13.01 | 3 of 3 | Electrical<br>Terminal points of Contractor's electrical scope, applicable for all systems/ subsystems described in relevant clauses for SCOPE is given below: (i) Terminals of Employers HT switchgear. | NTPC is requested to provide the location of Employers 11 KV switch board. | Employer's 11kV switchgear is located in main power house building. |

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| | **FGD SYSTEMS** | | | | | |
| 1625. | Section-VI<br>Part-B<br>SUB-SECTION-IV-D<br>CIVIL WORKS | 6.08.00 | 24 of 69 | Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings all shall be through cage ladder as per requirement. | Bidder understands that Gypsum Dewatering Building,FGD Control room,MCC building,Ball mill building ,Slurry Recirculation pump house,Oxidation blower are RCC framed building with Brick walls.<br><br>In addition No wall / Cladding shall be provided for areas where Blower,Slurry Recirculation Pumps,Dewatering equipment, Limestone Ball mill were located since these areas need maintenance acess for the above equipments. However Electrical Control room,MCC room will be enclosed type with Brick walls.<br>NTPC to confirm. | Bidder shall comply with technical specification requirement. |
| 1626. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 7.07.07 | 28 of 51 | All piping, valves & instrumentation upto the employer's terminal point shall be in the contractor's scope. Contractor shall provide the complete lime dosing system (in projects where | NTPC to furnish the size of Lime powder and inform whether the lime will be supplied in the form of bags or transported through truck. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | FGD SYSTEMS | | | | | |
| | | | | separate Zero Liquid Discharge system for waste water treatment is not in the scope of the contractor) to correct the pH of the waste water by lime (83% purity) dosing shall be provided and after mixing of the effluent (using re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. | | |
| 1627. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 7.07.02 | 27 of 51 | The secondary hydrocyclone feed tank shall be sized to provide a minimum storage of 1 hr of primary hydrocyclone overflow with all the units operating at Design Point and no outflow from the tank. | The partial flow from primary hydrocyclone would be sent to filtrate tank and controlled flow as per purging requirement would be sent to secondary hydrocyclone.Hence secondary hydrocyclone feed tank will be sized for 1 hour storage of designed purge flow. NTPC to confirm. | Specification requirement is clear at cl. 7.07.02. Bidder shall comply with the specification requirements. |

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| | **FGD SYSTEMS** | | | | | |
| 1628. | Section-VI, Part-A SUB-SECTION-V SALAIENT DESIGN DATA & SIZING | 5.01.00 | 8 of 26 | The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. | Since new wet chimney will be handling only low flue gas temperature, Bidder proposes Fibre Glass Reinforced plastic as the alternate MOC (instead of MS with cladding ) for flues of 250 MW units of Nabinagar plant. NTPC to confirm. | Specification requirement is clear at cl. 5.01.00. Bidder shall comply with the specification requirements. |
| 1629. | Section-VI Part-B Sub Sec-I-M1 (FGD) | 7.04.01 | 26 of 51 | Chloride content < 100 ppm | In some of the plants, the chloride level of clarified water is high to achieve the desired chloride of 100 ppm in gypsum, NTPC to advise whether chloride levels of clarified water available in these plants can be lowered. NTPC to confirm. | Specification requirement is clear at cl. 7.04.01. Bidder shall comply with the specification requirements. |

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| | **FGD SYSTEMS** | | | | | |
| 1630. | Section-VI<br>Part-A<br>Sub Sec-III-A1-(FGD) | 25.00.05 | 9 of 9 | **Wet Stack Condensate Collection system**<br>Storage tank/neutralization tank shall be complete with dosing, mixing and preparation system. After neutralization of the stack condensate collection, same shall be pumped to common drain system. Contractor shall provide 2 X100% pumps, complete with valves, piping fittings, level control/monitoring etc. Alternatively, bidder may propose its proven system for disposal of the condensate system in its bid for Employer's consideration. All the material in contact with the condensate shall be of suitable material for the operating duty | Since, condensate collected at the wet stack would be recycled back to absorber, neutralization of the stack condensate is not considered. NTPC to confirm. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | **FGD SYSTEMS** | | | | | |
| 1631. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 5.01.00 a(v) | 14 of 51 | Minimum 10% spare nozzles shall be provided at each level. | Since a complete spray level for recirculation has been kept as standby, no separate margin on nozzle quantity is required for individual spray level. Hence, it is presumed that 10% spare nozzles would be required only if spare spray level is not provided. NTPC to confirm. | Specification requirement is clear at cl. 5.01.00 a(v). Bidder shall comply with the specification requirements. |
| 1632. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 5.06.18 (iv) | 20 of 51 | A flushing device of the spray levels with water shall be installed. Flushing shall take place if spray levels are out of operation. | Ithe spray headers proposed are of self draining type and does not require separate flushing system. Hence no flushing considered for spray levels. NTPC to confirm. | Specification requirement is clear at cl. 5.06.18(iv) . Bidder shall comply with the specification requirements. |
| 1633. | Section-VI<br>Part-B<br>Sub Sec-I-M1 (FGD) | 5.06.15 | 19 of 51 | The other bridges(supports) shall be lined with minimum 2 Alloy 59/C276 | NTPC to advise whether Flake glass lining can alternatively be considered for support trusses of Spray headers and Mist eliminators. | Specification requirement is clear at cl. 5.06.15. Bidder shall comply with the specification requirements. |

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| | **FGD SYSTEMS** | | | | | |
| | | | | | | |
| | **BOP SYSTEM** | | | | | |
| 1634. | Section VI/Part A | 4.04.02 | 15 of 19 | FGD WASTE WATER TREATMENT SYSTEM FOR ZERO LIQUID DISCHARGE (ZLD) Bidder/Bidder's Sub vendor should have designed, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number of FGD Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser, Vapour Compressor) operating in Coal fired unit(s) of power plant, having inlet feed as FGD waste water of TDS not less than 30,000 | NTPC is requested to approve the vendors those have supplied ZLD system in industries other than FGD waste water treatment. | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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| | FGD SYSTEMS | | | | | |
| | | | | ppm and treatment capacity of not less than 10 m3/hr. The above FGD Waste Water Treatment System should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. | | |
| 1635. | Section VI / Part -B / I-M6 | 3.1.0 | 2 of 73 | Limestone received through Indian railway rakes will be unloaded in one of these three side discharge wagon tipplers or track hopper. | Please clearly specify which track hopper / wagon tippler will received the Lime stone for each 11 nos of project | Either of Wagon Tippler or Track Hopper shall be used for unloading of limestone received using Indian Railways rakes as per availability. |
| 1636. | Section VI / Part -B / I-M6 | 3.1.0 | 2 of 73 | Limestone received through Indian railway rakes will be unloaded in one of these three side discharge wagon tipplers or track hopper. | Limestone will be received through existing coal handling system from track hopper / wagon tippler hence any wagon tippler, side arm charger along with its shed, track hopper along with its shed , plough at unloading area is not in bidder | Bidder's understanding is correct. For railway rake unloading facilities of existing coal handling plant shall be used. |
| | Sub Section III / Part A /A5 | 2.01.01 | 2 of 6 | | | |

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| | **FGD SYSTEMS** | | | | | |
| | | | | | Scope. | |
| 1637. | Section VI / Part -B / I-M6 | 3.2.0 | 2 of 73 | "As received" limestone shall be fed on the double stream conveyors from where the same shall be conveyed upto the crushers. **The crushed limestone shall be conveyed by double stream conveyors up to the limestone storage shed. From the limestone storage shed paddle feeders will extract**! reclaim crushed limestone and feed the same onto double stream conveying system up to the limestone mill bunkers. | NTPC to clarify whether Paddle feeder below reclaim hopper shall be of 1 x 100 % or 2 x 100% capacity. | Bidder shall comply with the technical specification stipulations. |
| | Section VI /Sub Section V / Part A | 10.07.00 | 22 of 26 | paddle feeders 1 x 100% | | |
| 1638. | Section VI / Part -B / I-M6 | 4.1.7 | 5 of 73 | Conveyor bridges | NTPC to provide typical cross section of Conveyor Bridges if any | The same shall be provided to the successful bidder. |

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| | **FGD SYSTEMS** | | | | | |
| 1639. | Section VI / Part -B / I-M6 | 4.13.18 | 20 of 73 | Dust extraction system for limestone handling system shall be dry type comprising of dust collection hoods, ducting, fans, bag filter and dust collection hopper. The limestone dust collected in dust collection hopper shall be periodically emptied back to the conveyor leaving the building | NTPC to clarify whether DE system for Lime stone handling shall be of Dry type or Wet Type. | DE system shall be dry type for Lime stone Handling and Gypsum Handling system.<br><br>Bidder to refer Amendment in this regard. |
| 1640. | Section VI /Sub Section V / Part A | 10.15.00 | 25 of 26 | Dust Extraction system shall be ventury type | | |
| 1641. | Section VI /Sub Section V / Part A | 11.01.00 | 25 of 26 | The Rated Capacity of the reclaimer conveyor 150 TPH | NTPC to clarify whether the rated capacity of reclaim conveyor shall be as per tender or it can be decided by the bidder based on the lime stone consumption for FGD. | Bidder shall comply with the technical specification stipulations |
| 1642. | Section VI /Sub Section V / Part A | 11.02.00 | 26 of 26 | The covered storage shed / silo for limestone shall be sufficient to store limestone equivalent to consumption of minimum 7 days | It is presumed that 7 days storage is based on actual limestone consumption (averaged) and not reclaim conveyor capacity. NTPC to confirm. | Bidder to refer Amendment regarding Crushed Limestone storage capacity. |

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| | FGD SYSTEMS | | | | | |
| | ELECTRICAL | | | | | |
| 1643. | Section VI / part A / Sub section III B | 1.02.00 | 1 of 6 | HT and 415V Switchgear / Motor Control Centers (as shown in Electrical Single line diagram Drg. No. 0011-019-POE-J-001) | We understand that the Electrical distribution for each site as below.<br>- 11KV Power supply of FGD package will received from Client 11KV Switchgear AHP / CHP breaker feeder.<br>- Existing AHP / CHP feeder cables shall be replaced from existing 11KV Switchgear to FGD 11KV Switchgear.<br>- AHP / CHP 11KV Switchgear incoming cable replacing work is in Bidder scope.<br>- Our scope is start from outgoing terminal of existing 11KV Switchgear<br><br>NTPC to confirm. | Refer amended Tender SLD & electrical sope. |

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| | FGD SYSTEMS | | | | | |
| 1644. | Section VI / part A / Sub section III B | 1.02.00 | 1 of 6 | HT and 415V Switchgear / Motor Control Centers (as shown in Electrical Single line diagram Drg. No. 0011-019-POE-J-001) | NTPC to provide the following details<br>- Load details for Existing AHP /CHP switchgear<br>- Cable length between Existing 11KV switchgear to FGD 11KV Switchgear<br>- Cable length between FGD 11KV switchgear to Existing AHP / CHP 11KV switchgear | Refer amended tender SLD.<br>-Cable length shall decided by bidder during detail engineering based on GLP. |
| 1645. | Section VI / part A / Sub section III B | 1.09.00 | 3 of 6 | Complete Lighting system for internal and external areas for the plant, Building, Chimney and equipment in the bidder scope. | Lighting shall be provided for Bidder supplied FGD package only in our scope. For other area including street, road lighting and chimney lighting are in client scope.<br><br>NTPC to confirm. | Bidder shall comply the requirement of technical specifications. |
| 1646. | Section VI / part A / Sub section III B | 1.13.00 | 5 of 6 | Type Test | Type test reports for identical equipments shall be furnished. Separate type tests shall not be carried out for any electrical equipment. | Bidder shall comply the requirement of technical specifications. |
| 1647. | Section VI / part B / Sub section II E1 | 1.01.00 | 1 of 7 | Design ambient temperature : 50°C | We have considered the design ambient temperature for VFD (If applicable) and DG set shall | Bidder shall comply the requirement of technical specifications. |

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| | **FGD SYSTEMS** | | | | | |
| | | | | | be 40°C and all other shall be 50°C.<br>NTPC to confirm. | |
| 1648. | Section VI / part B / Sub section II E1 | 2.01.01 | 3 of 7 | Adequate number of auxiliary transformers shall be provided to meet the demand on 11kV, 3.3KV and 415V systems under most onerous conditions, with the criteria that each 11kV / 3.3KV / 415 V switchgear / MCC / DB shall be fed by 2x100% or 3 X 50 %, 3x100% transformers / feeders, and these shall be rated to carry the maximum load expected to be imposed. | We have considered all transformers shall be 2x100% or 3x50% only. Any 3x100% configuration is not considered.<br>NTPC to confirm. | Confirmed. |
| 1649. | Section VI / part B / Sub section II E1 | 2.05.00 | 4 of 7 | (a) All the 11 KV/ 3.3 KV & LT Incomers, Ties , Bus couplers, Transformer feeders shall be controlled from Switchgear SCADA and also from DDCMIS. | We understand that all the 11 KV/ 3.3 KV & LT Incomers, Ties , Bus couplers, Transformer feeders shall be controlled from purchaser SCADA system. New SCADA system is not required.<br><br>NTPC to confirm. | Refer amendment to the technical specifications. |

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| 1650. | Section VI / part B / Sub section II E1 | 2.08.00 | 5 of 7 | Complete DC system, comprising of batteries, battery charges, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous float voltage including suitable temperature correction factors. | Common one no. of 110V DC system shall be considered for both units FGD package. Battery shall be Ni-Cd type<br>NTPC to confirm | Bidder shall comply the requirement of technical specifications. |
| 1651. | Section VI / part B / Sub section II E1 | 2.09.00 | 6 of 7 | DG set(s) shall be capable of meeting 100 % of essential load<br>requirements of FGD System including starting of the largest motor (DOL) with other loads connected without exceeding the permissible starting voltage drop. | We understand that the DG set shall be sized 100 % of essential load requirements of FGD System including starting of the largest low voltage essential (415V) motor (DOL). Any HT motors or non essential motors are not considered.<br>NTPC to Confirm | Confirmed. |
| | **PROJECT SPECIFIC INFORMATION** | | | | | |
| | **KUDGI-(3X800MW)-A1** | | | | | |
| 1652. | Section VI / Sub Section -II-A1 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture per- | Specification requirement is clear. Bidder shall comply with the specification |

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| | **FGD SYSTEMS** | | | | | |
| | | | | | centage of limestone for proper selection and sizing of the Limestone crusher and Screen | requirements. |
| 1653. | Section VI / Sub Section -II-A1 | General Layout Plan | 9573-999 - POC -F - 001-Rev-6D1 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided |
| 1654. | Section VI / Sub Section -II-A1 | General Layout Plan | 9573-999 - POC -F - 001-Rev-6D1 | Facilities for Stage -I Facilities for Stage-II | NTPC to Clarify for unloading of Lime stone from Rakes which facility shall be consider stage - I or Stage II Or for Both Facilities separate Limestone handling and FGD shall be consider | Bidder to refer the revised GLP in issued amendments. |
| 1655. | Section VI / Sub Section -II-A1 | General Layout Plan | 9573-999 - POC -F - 001-Rev-6D1 | | Facility for Stage :1<br>1. Please provide detail / GA drawing of Tunnel at Conv.1 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B<br>3.GA drawing of conv 1A/B & conv 2A/B<br>4. G.A. Drawing of transfer towers ( TP-1 & TP-02) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO- | Only PDF provided.<br><br>Bidder to refer the revised GLP in issued amendments. |

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| | **FGD SYSTEMS** | | | | | |
| | | | | | CAD format | |
| 1656. | Section VI / Sub Section -II-A1 | General Layout Plan | 9573-999 - POC -F - 001-Rev-6D1 | | Facility for Stage :2<br>1. Please provide detail / GA drawing of Tunnel at WT 6 ,7&8<br>2.Detail / GA drawing of tunnel for Conveyor below Wagon Tippler<br>3.GA drawing of Conveyor below Wagon Tippler<br>4. G.A. Drawing of transfer tower (TP18 & TP19) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments.<br>Only PDF provided. |
| | **LARA-(2X800MW)-A2** | | | | | |
| 1657. | Section VI / Sub Section -II-A2 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture per- | Specification requirement is clear. Bidder shall comply with the specification |

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| | **FGD SYSTEMS** | | | | | |
| | | | | | centage of limestone for proper selection and sizing of the Limestone crusher and Screen | requirements. |
| 1658. | Section VI / Sub Section -II-A2 | General Layout Plan | 9548-999 - POC -F - 001-Rev-6D0 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided. |
| 1659. | Section VI / Sub Section -II-A2 | General Layout Plan | 9548-999 - POC -F - 001-Rev-6D0 | | 1. Please provide detail / GA drawing of Tunnel at Conv.1 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B<br>3.GA drawing of conv 1A/B & conv 2A/B<br>4. G.A. Drawing of transfer towers ( TP-1 & TP-02) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments.<br><br>Only PDF provided. |
| | **GADARWARA-(2X800MW)-A3** | | | | | |
| 1660. | Section VI / Sub Section -II-A3 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the | Specification requirement is clear. Bidder shall comply with the specification requirements. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | | Limestone crusher and Screen | |
| 1661. | Section VI / Sub Section -II-A3 | General Layout Plan | 9572 -999 -POC -F -001-Rev-5D1 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided. |
| 1662. | Section VI / Sub Section -II-A3 | General Layout Plan | 9572 -999 -POC -F -001-Rev-5D1 | | Facility for Stage :1<br>1. Please provide detail / GA drawing of Tunnel at Conv.1A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B<br>3.GA drawing of conv 1A/B & conv 2 A/B<br>4. G.A. Drawing of transfer tower (TP-1 & TP-2) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments.<br><br>Only PDF provided. |
| | **DARLIPALLI-(2X800MW)-A4** | | | | | |
| 1663. | Section VI / Sub Section -II-A4 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the | Specification requirement is clear. Bidder shall comply with the specification requirements. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | | Limestone crusher and Screen | |
| 1664. | Section VI / Sub Section -II-A4 | General Layout Plan | 9549 -999 - POC -F - 001-Rev-9 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided. |
| 1665. | Section VI / Sub Section -II-A4 | General Layout Plan | 9549 -999 - POC -F - 001-Rev-9 | | 1. Please provide detail / GA drawing of Tunnel at Conv.1 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B & 3A/B<br>3.GA drawing of conv 1A/B ,Conv 2A/B & conv 3 A/B<br>4. G.A. Drawing of transfer towers ( TP1 & TP 2) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format2 | Bidder to refer the revised GLP in issued amendments.<br><br>Only PDF provided. |
| 1666. | Section VI / Sub Section -II-A4 | Project Information/ 7.00.01 | 10 of 30 | The corresponding bore logs are enclosed at annexure- IV | Please provide bore logs data, since annexure IV is not enclosed | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| | **MOUDA-II-(2X660MW)-A5** | | | | | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1667. | Section VI / Sub Section -II-A5 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the Limestone crusher and Screen | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1668. | Section VI / Sub Section -II-A5 | General Layout Plan | 9561 / 9575 -999 -POC -F -001-Rev-11-D0 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided. |
| 1669. | Section VI / Sub Section -II-A5 | General Layout Plan | 9561 / 9575 -999 -POC -F -001-Rev-11-D0 | Facilities for Stage -I<br>Facilities for Stage-II | Please Clarify for unloading of Lime stone from Rakes which facility shall be consider stage -I or Stage II Or for Both Facilities separate Limestone handling and FGD shall be consider | Bidder to refer the revised GLP in issued amendments. |
| 1670. | Section VI / Sub Section -II-A5 | General Layout Plan | 9561 / 9575 -999 -POC -F -001-Rev-11-D0 | | Facility for Stage :1<br>1. Please provide detail / GA drawing of Tunnel at Conv.1 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B<br>3.GA drawing of conv 1A/B & conv 2 A/B<br>4. G.A. Drawing of transfer tower TP 1 & 2 before existing | Bidder to refer the revised GLP in issued amendments.<br><br>Only PDF provided. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | | coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | |
| 1671. | Section VI / Sub Section -II-A5 | General Layout Plan | 9561 / 9575 -999 -POC -F -001-Rev-11-D0 | | Facility for Stage :2<br>1. Please provide detail / GA drawing of Tunnel at Conv.14 A/B<br>2.Detail / GA drawing of tunnel for Conveyor15A/B<br>3.GA drawing of conv 14A/B , conv 15 A/B<br>4. G.A. Drawing of transfer tower (TP13 &14 ) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments.<br>Only PDF provided. |
| | **SOLAPUR-(2X660MW)-A6** | | | | | |
| 1672. | Section VI / Sub Section -II-A6 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the | Specification requirement is clear. Bidder shall comply with the specification requirements. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | | Limestone crusher and Screen | |
| 1673. | Section VI / Sub Section -II-A6 | General Layout Plan | 9571 -999 -POC -F -001-Rev-5D0 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided. |
| 1674. | Section VI / Sub Section -II-A6 | General Layout Plan | 9571 -999 -POC -F -001-Rev-5D0 | | 1. Please provide detail / GA drawing of Tunnel at Conv.1 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B<br>3.GA drawing of conv 1A/B & conv 2 A/B<br>4. G.A. Drawing of transfer tower (UGTP 1)before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments.<br><br>Only PDF provided. |
| 1675. | Section VI / Sub Section -II-A6 | Project Information/ 7.00.01 | 10 of 30 | The corresponding bore logs are enclosed at annexure- IV | Please provide bore logs data, since annexure IV is not enclosed | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| | **TANDA-II-(2X660 MW)-A7** | | | | | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1676. | Section VI / Sub Section -II-A7 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the Limestone crusher and Screen | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1677. | Section VI / Sub Section -II-A7 | General Layout Plan | 9562-999 -POC -F -001-Rev-8D1 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only pdf provided. |
| 1678. | Section VI / Sub Section -II-A7 | General Layout Plan | 9562-999 -POC -F -001-Rev-8D1 | | Facility for Stage :1<br>1. Please provide detail / GA drawing of Tunnel at Conv.1 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B<br>3.GA drawing of conv 1A/B & conv 2 A/B<br>4. G.A. Drawing of transfer tower TP 1 & 2 before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTOCAD format | Bidder to refer the revised GLP in issued amendments.<br>Only PDF provided. |
| | **NABINAGAR-(3X660MW)-A8** | | | | | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1679. | Section VI / Sub Section -II-A8 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the Limestone crusher and Screen | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1680. | Section VI / Sub Section -II-A8 | General Layout Plan | 0370 -999 - POC -A - 001-Rev-A | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided. |
| 1681. | Section VI / Sub Section -II-A8 | General Layout Plan | 0370 -999 - POC -A - 001-Rev-A | | Facility for Stage :1<br>1. Please provide detail / GA drawing of Tunnel at Conv.1 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B<br>3.GA drawing of conv 1A/B & conv 2 A/B<br>4. G.A. Drawing of transfer tower TP 1 & 2 before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments.<br><br>Only PDF provided. |
| | **MEJA-(2X660MW)-A9** | | | | | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1682. | Section VI / Sub Section -II-A9 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the Limestone crusher and Screen | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1683. | Section VI / Sub Section -II-A9 | General Layout Plan | 0360 / 0361 -999 - POC -F - 001-Rev-6- D0 | PDF Drawing | NTPC is requested to provide the Autocad drawing | |
| 1684. | Section VI / Sub Section -II-A9 | General Layout Plan | 0360 / 0361 -999 - POC -F - 001-Rev-6- D0 | Facilities for Stage -I Facilities for Stage-II | Please Clarify for unloading of Lime stone from Rakes which facility shall be consider stage - I or Stage II Or for Both Facilities separate Limestone handling and FGD shall be consider | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1685. | Section VI / Sub Section -II-A9 | General Layout Plan | 0360 / 0361 -999 - POC -F - 001-Rev-6- D0 | | Facility for Stage :1<br>1. Please provide detail / GA drawing of Tunnel at Conv.1 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 2A/B<br>3.GA drawing of conv 1A/B & conv 2 A/B<br>4. G.A. Drawing of transfer tower TP 13 before existing | Bidder to refer the revised GLP in issued amendments.<br>Only PDF provided. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | | coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | |
| 1686. | Section VI / Sub Section -II-A9 | General Layout Plan | 0360 / 0361 -999 -POC -F -001-Rev-6-D0 | | Facility for Stage :2<br>1. Please provide detail / GA drawing of Tunnel at Conv.29 A/B<br>2.Detail / GA drawing of tunnel for Conveyor15A/B & 16A/B<br>3.GA drawing of conv 15A/B , conv 16 A/B & Conv.29A/B<br>4. G.A. Drawing of transfer tower (TP15 &16 ) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments.<br><br>Only PDF provided. |
| | **BARH-I-II-A10 BARH STPP-I** | | | | | |
| 1687. | Section VI / Sub Section -II-A10 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the | Specification requirement is clear. Bidder shall comply with the specification requirements. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | | Limestone crusher and Screen | |
| 1688. | Section VI / Sub Section -II-A10 | General Layout Plan | 9558 / 9560 -999 -POC -F -001-Rev-8-D0 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided |
| 1689. | Section VI / Sub Section -II-A10 | General Layout Plan | 9558 / 9560 -999 -POC -F -001-Rev-8-D0 | Legend : 5 Facilities for Stage -I<br>Legend: 6 Facilities for Stage-II | Please Clarify for unloading of Lime stone from Rakes which facility shall be consider stage -I or Stage II Or for Both Facilities separate Limestone handling and FGD shall be consider | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1690. | Section VI / Sub Section -II-A10 | General Layout Plan | 9558 / 9560 -999 -POC -F -001-Rev-8-D0 | | Facility for Stage :1<br>1. Please provide detail / GA drawing of Tunnel at Conv.14 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 1A/B<br>3.GA drawing of conv 1A/B & conv 14 A/B<br>4. G.A. Drawing of transfer tower before existing coal Crusher House | Bidder to refer the revised GLP in issued amendments.<br>Only PDF provided. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | | Please note all above drawing shall be provide in the AUTO-CAD format | |
| 1691. | Section VI / Sub Section -II-A10 | General Layout Plan | 9558 / 9560 -999 -POC -F -001-Rev-8-D0 | | Facility for Stage :2<br>1. Please provide detail / GA drawing of Tunnel at Conv.30 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 31A/B & 15A/B<br>3.GA drawing of conv 31A/b & conv 15 A/B<br>4. G.A. Drawing of transfer tower (TP25) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments. |
| | **BRBCL-(Nabinagar-4x250MW)-A11** | | | | | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1692. | Section VI / Sub Section -II-A11 | Project Information | - | | NTPC is requested to provide Sieve analysis , moisture percentage of limestone for proper selection and sizing of the Limestone crusher and Screen | Specification requirement is clear. Bidder shall comply with the specification requirements. |
| 1693. | Section VI / Sub Section -II-A11 | General Layout Plan | 0270-999-POC-F-001-Rev-6 | PDF Drawing | NTPC is requested to provide the Autocad drawing | Only PDF provided. |
| 1694. | Section VI / Sub Section -II-A11 | General Layout Plan | 0270-999-POC-F-001-Rev-6 | | 1. Please provide detail / GA drawing of Tunnel at Conv.9 A/B<br>2.Detail / GA drawing of tunnel for Conveyor 1A/B<br>3.GA drawing of conv 1A/B & conv 9 A/B<br>4. G.A. Drawing of transfer tower(TP1) before existing coal Crusher House<br>Please note all above drawing shall be provide in the AUTO-CAD format | Bidder to refer the revised GLP in issued amendments.<br><br>Only PDF provided. |
| | **CIVIL** | | | | | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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| | **FGD SYSTEMS** | | | | | |
| 1695. | General (Project Information) | 7.00.01 | 10 of 30 | Geotechnical data and foundation system for the respective projects are enclosed at annexure- III | NTPC is requested to provide the detailed soil report near by chimney area for all projects. | Bidder to refer Foundation system and geotechnical data chapter furnished in Project information chapter. |
| **1696.** | **COMMERCIAL** | | | | | |
| 1697. | Amendment no-1 to BDS (Sec-III) | ITB Clause no-26.4 | 1 of 1 | LF Component (CIF price quoted in Schedule-1 plus CIF value of Import content of Ex-Works price included in Schedule-2) quoted by Bidder shall in no case be more than 30% of the total supply value quoted by bidder in price schedule-1 plus price schedule-2. | In view of limited suppliers for FGD equipment within India, it is presumed that these clauses are applicable for imported Bought Out items only, and imported raw materials does not fall under purview of 30% of the supply value. Therefore value of imported raw materials should be excluded and can be over and above this proposed limit of 30%. NTPC to clarify. | Bidder to refer clarifications being issued separately. |
| | Amendment no-1 to Technical Specification (Section-VI) | Sl.no-1 | 1 of 1 | Government of India has launched " Make in India" initiative to transform India into a global Design and manufacturing hub. Accordingly, to promote manufacturing within India, the import content in flue gas Desulphurisation (FGD) system package has been restricted | | |

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| | FGD SYSTEMS | | | | | |
| | | | | to 30% of the total supply value quoted by bidder in Price schedule-1 plus Schedule-2. Bidder shall ensure that it does not import more than 30% of its supplies and shall manufacture/source equipments/components from within India to meet the aforesaid statement. | | |
| 1698. | Section - II (ITB) | Clause No 1.0 (E ) | 1 of 41 | Price bids submitted by the Bidder shall be opened and evaluated separately for each Project in the sequence, the Projects are listed above at clause 1.0 (A). After opening of Price Bid for a particular Project, Reverse Auction among qualified Bidders shall be carried out for that Project to arrive at the lowest evaluated Bid. Price bid of a Bidder for the next project shall be opened after the | NTPC is requested to clarify if bidder can choose projects of their choice in case they are L1 in more than the number of projects they have opted for and submitted security deposit. | |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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| | FGD SYSTEMS | | | | | |
| | | | | completion of Reverse Auction of previous Project. However, in case eligible bidders (for Reverse Auction Process) for any Project(s) are three or less then price bid for that Project(s) may be opened after completion of Reverse Auction of other Projects. | | |
| 1699. | SECTION-IV GENERAL CONDITIONS OF CONTRACT (GCC) | 10 | 17 of 63 | Employer's Responsibilities | a. Whether proper space at site for hutments, covered office space with utilities, covered storage space for keeping the equipments/machinery and tools and tackles of the Contractor etc., will be provided by the Employer. Employer to clarify.<br><br>b. Whether Employer will issue required forms, applications including Form- V to enable Contractor / Sub-Contractors to comply with la- | Bidder to refer clarifications being issued separately. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | | bor laws. | |
| 1700. | SECTION-IV GENERAL CONDITIONS OF CONTRACT (GCC) | 13.2.2 | 19 of 63 | Advance Payment Security | As per this clause Bank Guarantee is to be reduced prorata every three months. However said provision is not appearing in the format provided for Advance Payment Security. Suitable modification in ABG format needs to be made. Employer to confirm. | Bidder to refer clarifications being issued separately. |
| 1701. | SECTION-IV GENERAL CONDITIONS OF CONTRACT (GCC) | 25.2 | 39 of 63 | Guarantee Test | a. There is no provision of deemed fulfillment of Functional Guarantees and as per the Contract the Contractor shall be obliged to conduct the same even after 12 months from date of Completion de- | Bidder to refer clarifications being issued separately. |
| | SECTION-V SPECIAL CONDITIONS OF CON- | 13 | 6 of 15 | Guarantee Tests and Operational Acceptance | | |

# CLARIFICATION No.01 (TECHNICAL)
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| | **FGD SYSTEMS** | | | | | |
| | TRACT (SCC) | 14 | 6 of 15 | GCC Clause | spite delay on the part of Employer. Could a cap on time period for Guarantee Test be put? Please confirm.<br><br>b. Could need of additional Bank Guarantees (Cl. 14 of SCC) be omitted in view of the fact that the payment is delayed for the reasons not attributable to the Contractor. | Bidder to refer clarifications being issued separately. |
| 1702. | SECTION-IV GENERAL CONDITIONS OF CONTRACT (GCC) | 27.2<br>27.8 | 41 of 63<br>42 of 63 | Defect Liability | a. As per clause 27.2 of GCC, the Defect Liability Period is to be commenced from Completion of Facilities or Operational Acceptance of the Facilities, whichever occurs first. It could be possible that there may be delay for the reasons not attributable to the Contractor in such event the warranty period may also be counted from the last major supply. Accordingly could it be possible to make a third limb for Defect Liability Period i.e. __ months from the | Bidder to refer clarifications being issued separately. |

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| | **FGD SYSTEMS** | | | | | |
| | | | | | last major supply? Employer to clarify | |
| 1703. | SECTION - V SPECIAL CONDI-TIONS OF CON-TRACT (SCC) | 16<br>17 | 10 of 15 | Completion Time Guarantee Functional Guarantees | Tender is silent on cumulative Liquidated Damages payable under the Contract for delay and shortfall in performance guarantees. Employer to please clarify. | Bidder to refer clarifications being is-sued separately. |
| 1704. | SECTION-IV GENERAL CONDI-TIONS OF CON-TRACT (GCC) | 26<br>28 | 40 of 63<br>43 of 63 | Completion Time Guarantee Functional Guarantees | | Bidder to refer clarifications being is-sued separately.<br>. |
| 1705. | SECTION-IV GENERAL CONDI-TIONS OF CON-TRACT (GCC) | 40 | 55 of 63 | Extension of Time for Comple-tion | This clause and other part of the Contract are silent on over-head costs except for bank charges & insurance on fixed rates, in case of delays attribut-able to the Employer. Employ-er to consider above request and provide an appropriate provision in this clause on this aspect. | Bidder to refer clarifications being is-sued separately. |
| | SECTION-V SPECIAL CONDI-TIONS OF CON-TRACT (SCC) | 19 | | | | Bidder to refer clarifications being is-sued separately. |

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## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

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| | **FGD SYSTEMS** | | | | | |
| 1706. | SECTION-IV GENERAL CONDITIONS OF CONTRACT (GCC) | 3.6.1 | 5 of 63 | Construction of the Contract | Tender specifies that Three Separate Contracts will be signed. Employer is requested to clarify whether Separate GST Nos. can be considered for Supply of Goods and Supply of Services. For Example: For First Contract, the Supply of Goods shall be executed from Noida GSTIN and For Second and Third Contracts, Supply of Services (erection, commissioning & Civil construction, etc.) shall executed from the GSTIN of the State where the Project is located. | Bidder to refer clarifications being issued separately. |
| 1707. | SECTION VII PART - 3 OF 3 5. FORM OF CONTRACT AGREEMENT | Appendix - 1 | | Schedule No. 4 : Installation Services (excluding Civil Works) | As per E/F(I)(B) II rate of interest on advance payment is mentioned as 12.60% per annum however as per Bank Guarantee format thereof it is mentioned as 14% per annum. Please clarify which one is correct. | Bidder to refer clarifications being issued separately. |

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|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1708. | SECTION II INSTRUCTION TO BIDDERS | 10.6 | 20 of 41 | Benefits/Exemptions to Supply for Mega Power Projects | NTPC to clarify whether only Basic Customs Duty is exempt on Imported Equipment under Mega Power Projects Policy or the exemption will be applicable on both Basic Customs duty and IGST. | Bidder to refer clarifications being issued separately. |
| | **CONTROL & INSTRUMENTATION** | | | | | |
| 1709. | Section-VI Part-B SUB-SECTION-I-M6 LIMESTONE HANDLING PLANT (LHP) | 4.02.00 | 61 OF 73 | All the above local control panels shall be accessible and located near their respective equipment and shall be complete with all the required controls, interlocks, annunciation's etc. However, for items (j.), above, controls shall be through contractor's PLC. Further, necessary controls, indications and annunciations for all the above equipment shall also be provided at main FGD Control Room as described under relevant clause. | Local control panel may consist of microprocessor based control system & connected to FGD PLC thru soft communication. NTPC to confirm | Bidder to follow specification requirements. |

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| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1710. | Section-VI<br>Part-B<br>SUB-SECTION-I-M6<br>LIMESTONE HANDLING PLANT (LHP) | 4.12.00 | 70 OF 73 | **Lime Sampling system**<br>(a) Lime Sampling Unit shall be controlled through PLC as per standard and proven practices of LSU equipment / LHP supplier, which will be located nearest MCC. Controls and interlocks for proper material flow shall be provided similar to conveyor system. Suitable Mimic shall be provided in the PLC.<br>(b) Lime Sampling Unit shall be controlled through main FGD DDCMIS. Controls and interlocks for proper material flow shall be provided similar to conveyor system. Mimic shall be provided in the Operator Work Station (OWS) at main FGD control room. | Lime Sampling Unit shall be controlled through LSU supplier PLC & connected to FGD PLC thru soft communication. NTPC to confirm | It is clarified that the lime sampling unit shall be controlled through FGD PLC. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1711. | SECTION-VI, PART-A SUB-SECTION-III-C (C&I) | 6.01.00 | 6 OF 8 | **CONTROL SYSTEM**<br>6.01.00 Instrumentation and Control System with interlocks, protection and annunciation for FGD system and other system being provided under the contract shall be provided with Software and hardware as required to provide a complete functioning of the system. Dual processor based PLC system with PC based Operator Work Station (OWS), programmable station and A4 size color Laser printer etc. on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). The PLC configuration | FGD system shall be controlled by PLC.<br>DDCMIS is not considered for the FGD system<br>NTPC to confirm | Bidder's understanding is correct. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | drawing shall be as per Tender drawing no. 0000-151-POI-A-013. | | |
| | Section-VI<br>Part-B<br>SUB-SECTION-I-M6<br>LIMESTONE HANDLING PLANT (LHP) | 3.3.0 | 59 OF 73 | **General Requirements**<br>The instruments and controls to be furnished and erected under this specification are as required for safe and satisfactory operation of the Lime Handling System, as outlined under mechanical section and as specified elsewhere in the specification. For the equipment and materials procured by the Contractor from his sub-vendors, the Contractor shall study the specification, safety requirements, interface drawings for such equipment and material in detail and | | Bidder's understanding is correct. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | shall coordinate his work with his sub vendors and FGD DDCMIS system and supply instrumentation and control to suit the actual Lime stone and Gypsum Handling equipment. | | |
| | | 3.04.02 | 60 OF 73 | **Design**<br>The complete lime handling plant shall be controlled from FGD DDCMIS system as detailed elsewhere. | | Bidder's understanding is correct. |
| | | 4.01.00 | 60 OF 73 | **Coal Handling Plant Main Control Room**<br>Overall, operation of the following equipment of Lime Handling Plant shall be controlled from the main FGD control room through FGD DDCMIS being provided by the Contractor. | | Bidder's understanding is correct. |
| 1712. | Section-VI<br>Part-A<br>Sub Sec-III-C | 2.02.00 | 2 OF 8 | Single Input DIN rail mounting type temp transmitters (mounted in JBs) shall be provided by | Head mounted or dual input DIN rail mounted temperature transmitters shall also be pro- | Bidder to follow specification requirement. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | the Contractor for all temperature elements under Contractor's scope. | vided as per contractor practice NTPC to confirm | |
| 1713. | Section-VI Part-A Sub Sec-III-C2 | 3.01.00 3.02.00 | 8/9 OF 34 | 3 Housing/Head : IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well. | | Bidder to follow specification requirement. |
| | | | | | | |
| 1714. | Section VI / Sub Section-III, A1 | 4.01.11 | Page 4 of 9 | All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers shall be in straight line. The building must be complete in all respect spe- | Since limited space allocated near Chimney area. For some of the Sites, Oxidation Blowers cannot be placed inline of Slurry Recirculation pumps. Anyhow, separate Enclosure Building with Hoists will be provided for Oxidation Blowers. | Bidder shall comply with the specification requirements. In case space is a constraint the same shall be reviewed and discussed after techno commercial bid submission. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| | | | | cially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc. The building shall be sufficiently ventilated. | | |
| 1715. | PART-B-I-MECH, SUB-SECTION-I-M1 | 16.01.05 | Page 39 of 61 (Page 42) | c) Duct stiffening shall be by means of rolled sections. No internal stiffeners shall be used for ducts from Absorber outlet to chimney inlet. | If the Duct Stiffning Beam size increased more 600mm Depth. Plate Fabricated Stiffening Beams will be used. | Bidders query is not clear. Bidder shall comply with the specification requirements. |
| 1716. | General Clarifications | | | | The allocated space near Existing Chimney is not sufficient for accommodating. Limestone Milling Unit. Hence, Limestone Milling Building is proposed near 7 Days Storage Unit. Kindly Review & advise. | Bidder shall comply with the specification requirements. In case space is a constraint the same shall be reviewed and discussed after techno commercial bid submission. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | FGD SYSTEMS | | | | | |
| 1717. | General Clarifications | | | | The Terminal point for Lime-stone Inlet is before Coal Crusher House of CHP. By tak-ing a Tap Off & running a Lime-stone conveyor from Tapped location to Allocated FGD Area, Instead of, We able to place Total Lime Handling System near Crushing Unit in the avail-able spaces without disturbing the existing Buildings. NTPC Has to review & advise the pro-posed location. Significant Con-veyor Lengths will be reduced in this scheme. | Bidder may come with proposal based on plant layout available in tender drawings and site visit.<br><br>NTPC reserves the right to freeze a basic layout for each NTPC plant post techno commercial bid discussions. |
| 1718. | General Clarifications | | | | All Applicable GA Drawings (Plan,Elevation & Sections) of existing Coal Handling Plant & CHP Cable Rack are required to prepare a Layout drawing of Limestone & Gypsum Convey-ing Package. | Bidder to refer the revised GLP in issued amendments. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | **FGD SYSTEMS** | | | | | |
| 1719. | General Clarifications | | | | Since the Piping, Cabling, Belt Conveyors of FGD Package has to run among & across the entire CHP, Coal Yard. Applicable GA Drawings are required. | Bidder to refer the revised GLP in issued amendments. |
| 1720. | **As per Individual Site Drawings** | | | | | |
| 1721. | TANDA Site Key Plan, 9562-999-POC-F-001, Rev-8D1 | | | As per Site Key Plan Received, Space for FGD allocated is not sufficient for accommodating Chimney. | As per Site Key Plan Received, Space for FGD allocated is not sufficient for accommodating Chimney. Hence New Wet Chimney is proposed at the Coordinate at 1090W & 655N. NTPC has to review and confirm. | Bidder to refer the revised GLP in issued amendments. |
| 1722. | TANDA Site Key Plan, 9562-999-POC-F-001, Rev-8D1 | | | As per Site Key Plan Received, Space for FGD allocated for Gypsum Yard & Limestone Storage Yard is at a Green Belt Area near Coordinates 930W & 980N | Since, Terminal Point of Limestone Tap off point is located before Coal Crusher House, We have to run Limestone Conveyors in the non allocated area to accommodate the Limestone Handling System. | Bidder to refer the revised GLP in issued amendments. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | FGD SYSTEMS | | | | | |
| 1723. | Nabinagar, 4 x 250MW Site Key Plan, 0270-999-POC-F-001- (Rev-6) | | | As per Site Key Plan Received, Space for FGD is allocated between 1449N & 1500N for all 4 FGD Units. | Since, we have space available after 1584N, We able to propose a 2 FGD Units in the empty space without disturbing the any of existing Plant. Kindly review & approve the proposed location. | Bidder shall comply with the requirement of Technical Specification. However, the requirement for space will be deliberated with the Bidders during post techno commercial bid discussion. |
| 1724. | Meja Site Key Plan, 0360-999-POC-F-001 - (Rev-6DO) | | | Space allocated for FGD Units are not sufficient to accommodate both FGD Units & Chimney. | Space allocated for FGD Units are not sufficient for accommodating both FGD Units. Hence, FGD Unit for Boiler -1 is proposed LHS side of ESP Unit-I between Cable Rack & ESP. NTPC has to review & advise the proposed location. | Bidder shall comply with the requirement of Technical Specification. However, the requirement for space will be deliberated with the Bidders during post techno commercial bid discussion. |
| 1725. | Solapur Site Key Plan, 9571-999-POC-F-001 - (Rev-5DO) | | | Space allocated for FGD Units(50m x 70m) are not sufficient to accommodate both FGD Units & Chimney. | Since allocated Space of 50m x 70m is not sufficient for accommodating both FGD Units. New Wet Chimney is proposed in Coordinates 1200E, 450N approximately. Kindly review & advise the proposed location. | Bidder shall comply with the requirement of Technical Specification. However, the requirement for space will be deliberated with the Bidders during post techno commercial bid discussion. |
| 1726. | Solapur Site Key Plan, 9571-999-POC-F-001 - (Rev-5DO) | | | Space allocated for FGD Units(50m x 70m) are not sufficient to accommodate both FGD Units & Chimney. | Since allocated Space of 50m x 70m is not sufficient for accommodating both FGD Units. New FGD Unit-II for Boiler-II is proposed at 1200E, 500N approximately. | Bidder shall comply with the requirement of Technical Specification. However, the requirement for space will be deliberated with the Bidders during post techno commercial bid discussion. |

# CLARIFICATION No.01 (TECHNICAL)
## Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

| Sl.No | Section /Part / Chapter | Clause No. | Page No. | As per RFQ | Pre Bid Queries | NTPC Clarifications |
|---|---|---|---|---|---|---|
| | FGD SYSTEMS | | | | | |
| 1727. | Gadarwara Site Key Plan, 9572-999-POC-F-001 - (Rev-5D1) | | | | Space Provided near Existing Chimney is not sufficient to accommodate New Wet Chimney. Hence, Wet Chimney is proposed at Coordinate 17147N, 17180E approximately. Kindly review the proposed location and advise. | Bidder shall comply with the requirement of Technical Specification. However, the requirement for space will be deliberated with the Bidders during post techno commercial bid discussion. |
| 1728. | Mouda Site Key Plan, , 9561-999-POC-F-001 - (Rev-11-DO) | | | Space allocated for FGD Units(53m x 53m) are not sufficient to accommodate single FGD Unit & Chimney. | Space allocated near Existing Chimney for FGD Area is not sufficient for accommodating FGD Unit. Kindly advise an area planned for locating FGD Units. | Bidder shall comply with the requirement of Technical Specification. However, the requirement for space will be deliberated with the Bidders during post techno commercial bid discussion. |
| 1729. | 0011-109-POE-J-001 | GENERAL | | | 1. What the Capacity of CHP/AHP transformer?<br>2. How many sets of spare SWGRs for owner?<br>3 Pls provide cable routing drawing of power plant separately. | Point 1 & 2- Bidders to refer revised SLD issued with AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI).<br>3. To be finalized during detailed engineering. |

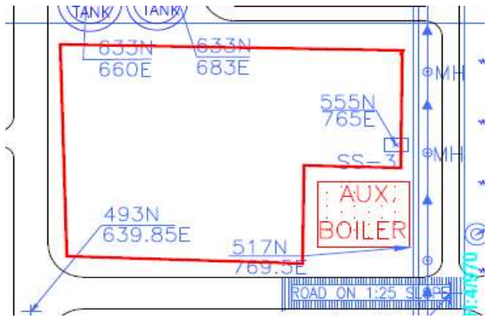
# Lot1A Flue Gas Desulpurization Package
## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 1 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl Number-35 | 13 of 60 | "Sub QR for civil works:"-Clause Deleted | Since the clause mention here appear in a number of place in the tender specification. We understand that the clause is deleted from where ever it appears. Please clarify. | Bidder's understanding is incorrect. For Sub-QR for civil works, bidder to refer clause no. 4.02.00, Sub-section-I Intent of specification, Section-VI, Part-A of technical specification |
| 2 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl Number-100 | 38 of 60 | The Maximum capacity of each Limestone storage Silo shall not exceed 2000 MT | Since the minimum capacity of limestone storage is 5000 MT, we request you to consider single silo size more than 2000MT. Please note that bigger silo are already in use in similar application in cement industries. Please note unnecessary limiting the silo capacity where space is a constrain will call for unnecessary cost implication and complications in layout. So request NTPC to delete this clause | Bidder to comply with technical specification stipulations |
| 3 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 97 | 35 of 60 | Unloading, Crushing and Bunker Feeding System | Kindly confirm the capacity of limestone unloading and conveying system upto crushed limestone storage area. | Capacity shall be 150 MTPH. |
| 4 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 142 C | 59 of 60 | 2x100% electric driven, single stage, integrally geared, single or dual vane(Helical lobe) type with VFD drive,oxidation blowers. | We request NTPC to also consider Multistage centrifugal blower for this purpose. Please confirm. | This is not clarification. Hence, bidder is requested to comply. |
| 5 | AMENDMENT NO.<br>CS-0011-109(1A)-2-AMDT-05(T) | 144 | 59 of 60 | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br>The absorber oxidation tank, absorber tower & absorber outlet duct shall be provided with 2 mm (minimum) thickness lining / cladding / Alloy C276 / Alloy 59 or better material. | Request NTPC to elaborate on the lining and cladding process. We understand that the cladding/lining with plug welding will also be acceptable. Please confirm. | It is clarified that only **cladded plate** of Alloy C276/ Alloy 59 or better material with Carbon steel base is allowed. Cladded plate can be manufactured by either rolling or explosion bonding process. |
| 6 | C&I Annexure I to X to AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 2.01.00<br>and 16.01.00 | 1 of 8<br>5 of 8 | Field instrument based on field bus | Per clause 2.01.00 field bus requirement for electronic transmitters is not specified. However in clause 16.01.00 it is stated that field bus for electronic transmitters is required. Please clarify whether the requirement is with field bus instruments and control system OR only with field bus compatible instruments. | Bidder to refer clause no. 1.01.00 (f), Sub section III-C, PART-A, "Scope of supply and services" wherein it is mentioned that fieldbus(FF/Profibus) based instruments (PT/DPT/TT), Fieldbus based Non-intrusive Electrical actuators are also envisaged which shall be connected to the DDCMIS. The protocol of fieldbus (FF/Profibus) for non-intrusive electric actuators and fieldbus based instruments shall be matching with fieldbus protocol of FGD System DDCMIS. Pl also refer clause no. 1.02.01, Sub section III-C, PART-A, "Scope of supply and services" wherein it is mentioned that Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications. In case non fieldbus based actuator or transmitters are required for few applications then the same shall be matching with fieldbus protocol of FGD System DDCMIS.<br>Pl also refer clause no. 1.02.01, Sub section III-C, PART-A, "Scope of supply and services" wherein it is mentioned that Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications. In case non fieldbus based actuator or transmitters are required for few applications then the same shall<br>be discussed and finalized during detailed engineering. |
| 7 | C&I Annexure I to X to AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 1.02.01 (D) | 3 of 19 | The design of control system cabinets with field bus components shall be finalized during detailed engineering stage | At present stage if we consider the transmitters with hardware communication and not with field bus then, the only thing that would get connected to DCS controller through field bus are actuators as specified in clause 4.00.00 (C&I annexures Page 3 of 4). Hence kindly clarify whether clause no 16.00.00 (C&I annexure Page 5 of 8) which is for field instruments based on field bus is valid or not, keeping in view the clarification requested in point no 11 above. This will decide the requirement of field bus component in DCS. | |
| 8 | C&I Annexure I to X to AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 3.07.00 | 8 of 23 | Note: For binary inputs, one changeover contact is counted as 2 inputs. | The note is not clear. Please clarify. | It is clarified that both contacts (i.e. 'NC' + 'NO' together) of changeover switch shall be wired to DDCMIS. Accordingly for binary inputs, one changeover contact is counted as 2 inputs. |
| 9 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 119 | Page 47 of 60 | A "wet Chimney" shall be ……without FGD system in operation. The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11. The top flue liner above the roof slab shall be made of solid C276 / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. …… | NTPC to provide the height of 10mm thick C276 / Titanium liner or elevation of roof slab. | The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner |

# Lot1A Flue Gas Desulpurization Package
## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 10 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 119 | Page 47 of 60 | ..... External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation. The wet stack shall be designed as per the guidelines of EPRI Revised Wet Stack Design Guide. Alternatively, ..... year full replacement guarantee and fulltime onsite QA supervision, during erection & commissioning, by the supplier of the lining system. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet. | Bidder understands that by providing 10 mm thick Titanium / C-276 liner (above roof slab), the following clauses are not applicable.<br>*"External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation."*<br>&<br>*"External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet."*<br>NTPC is requested to delete the same. | This clause will also be applicable |
| 11 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 52 | Page 20 of 60 | The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The analysis and design of wind shield shall be carried out as per IS 4998. The wind shield shall be analysed for cases with and without flue liner loads. | The bidder understands that wind shield shall be analysed and designed for cases with and without flue liner loads as per IS 4998 : 2015 (Design of Reinforced concrete chimneys - Criteria, 3rd revision) using limit state method. This is in line with CS-0011-109(1A)-2-AMDT-05(T); Sr.no 36; page 13 of 60.<br><br>NTPC is requested to confirm. | Bidders understanding is correct.The analysis and Design of wind shield shall be as per the latest chimney IS 4998:2015. |
| 12 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 145 | Page 60 of 60 | Thermal Insulation along with aluminium cladding shall be provided for all the equipment's/surfaces having skin temperature more than 60 degree Celsius except for absorber. Further, Thermal insulation of min 70 mm shall be provided for absorber outlet flue gas duct irrespective of skin temperature. | Bidder understands that thermal insulation of min 70 mm shall be provided for absorber outlet flue gas duct irrespective of skin temperature, while transition duct inside the chimney and chimney flue liner shall be painted with corrosion resistant paint in case of exterior surface temperature < 60 degrees.<br><br>NTPC is requested confirm. | Thermal insulation of min 70 mm shall be provided for absorber outlet flue gas duct irrespective of skin temperature. Transition duct inside the chimney and chimney flue liner shall be painted with corrosion resistant paint for Boro Silicate Lining and insulated for Titanium/C276 cladding irrespective of surface temperature. |
| | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 60 | Page 23 of 60 | All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) shall be painted as specified in corrosion protection clause of this specification. | | |
| 13 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 34(b) | Page 12 of 60 | The type of aviation obstruction lighting system shall be of high intensity aviation obstruction lights having an effective intensity of 4000 to 200,000 cd (minimum) depending upon back ground ..... The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc. | The bidder would like to consider providing high intensity aviation obstruction lights at only two levels for 150 m high chimney and three levels for 220 m high chimney stack. The same is in line with ICAO regulations.<br><br>NTPC is requested confirm. | Specification requirement is clear in this regards. Bidder to follow the technical specification requirement. Avaiation warning lights to be provided at three levels. |
| 14 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 46 | Page 16 of 60 | Single-flue chimney(s) shall be provided, except for Tanda TPP (2X660MW) and Meja TPP (2X660MW) where twin-flue Chimney shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point for single flue chimney shall be minimum 150 meters above the plant grade level and for twin flue chimney flue gas emission point shall be minimum 220m above the plant grade level. | For optimal layout, bidder requests NTPC to provide option for Single-flue Chimney(s) also for NTPC Tanda (2x660MW) and NTPC Meja (2x660MW), meeting all specification requirements for single flue chimney.<br><br>NTPC is requested confirm. | Option for single or twin flue is allowed for Tanda & Meja |

# Lot1A Flue Gas Desulpurization Package
## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 15 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 63 | Page 25 of 60 | General Layout Plan.....<br>7. Tanda (2x660 MW) 9562-999-POC-F-002 Rev.10 (Civil Annex 12)<br>..... | Space marked in the layout near to the stock pile is not adequate for fitment of all the FGD systems. Bidder requests NTPC to provide additional space in space for laydown & pre-assembly activities (future green belt area) Grids between 800W - 1200 W and 800N - 1200N | Bidder to accommodate the FGD facilities within space shown in tender drawing. |
| 16 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 63 | Page 25 of 60 | General Layout Plan.....<br>6. Solapur (2x660 MW) 9571-999-POC-F-001 Rev.6 (Civil Annex 11)<br>..... | Space provided in the amended layout is not sufficient to accomodate both units Absorbers along with the FGD MCC room. Bidder request NTPC to reconsider the earlier provided space near the Auxilary boiler for the FGD system. i.e at Grids between 600E - 800 E and 400N - 600N<br><br>NTPC is requested confirm.<br><br>  | Bidder to accommodate the FGD facilities within space shown in tender drawing. |
| 17 | SUB-SECT10N·I·M6 - Sec VI,Part B | Sl.no. 2.1.0 | Page 58 of 73 | Drive arrangement - Electric motor, scoop type hydraulic coupling, gear box. | As recommended by the hammer mill OEM's, it is generally recommneded to go with V-belt drive instead of scoop coupling with gear box. We have following advantages:<br>a) V belt acts as shock absorber, when crusher rotor is jam due to any tramp iron piece comes in between rotor, v belt will slip and damage to the motor is avoided.<br>b) There is service factor - 1.2, in such case there shall be loosening of one or two belts balance v-belts will take and power and crusher will run, in case of scoop coupling the crusher has to stopped.<br>OEM' s have supplied in most of the Cement Plant using v belt transmission for Limestone crushers of near about capacities(150 - 200 tph).<br>Bidder request NTPC to accept the same. | V belt drive is also acceptable for Hammer mill. |
| 18 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 121 | Page 48 of 60 | Waste Water<br>The Contractor guarantees that the maximum purge flow rate to waste water treatment system shall be 10m3/hr (except for BRBCL where it shall be less than 5 m3/hr) averaged over a 24 hour period from each unit. | Bidder envisages that the maximum purge flow rate to waste water treatment system for projects with 800 MW units shall be 15m3/hr averaged over a 24 hour period from each unit. | This is not clarification. Hence, bidder is requested to comply. |
| 19 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 119 | Page 47 of 60 | .....Cladding shall be done to achieve the required quality as per ASTM B 898-11. The top flue liner above the roof slab shall be made of solid C276 / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness..... | Please note that ASME SB265 is applicable for Titanium clad plate. For C276 cladding SA265 is applicable. Please confirm. | Bidder's understanding is correct. |
| 20 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 62 | Page 24 of 60 | All steel parts embedded in concrete like bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes. | Bidder envisages that for fasteners IS 1367, Part 13 will be followed. Please confirm. | Specification requirement is clear in this regard. Bidder to follow technical specification. |
| 21 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 140 | Page 56 of 60 | Barh-I (3X660MW) clauses and drgs revised considering that FGD outlet will<br>led to existing chimney and accordingly absorber discharge will be connected to ID fan discharge duct with additional damper(s)..... | As for Barh-I (3X660MW) the Flue gas is passing through existing chimney, bidder requests NTPC to kindly furnish the pressure required to be maintained at Chimney inlet at FGD design point. | For FGD design point, consider pressure drop of 40 mm through chimney or actual whichever is higher. |

# Lot1A Flue Gas Desulpurization Package
## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 22 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 136 (Mech Annexure-IV) | Page 3 of 3 | 5.00.00 AUXILIARY POWER CONSUMPTION (PA):<br><br>xxv. Power consumption of Gypsum conveying system (Single Stream) except Lighting, Hoists, Sump Pumps, DE, Ventilation, SW System, Potable water system. | Since limestone handling system & gypsum handling systems are common systems, bidder envisages to apply duty factor for gypsum handling system as 0.15 to the unitised power consumption. Accordingly, Pu for the same shall be duty factor x power consumption. Please confirm. | Bidder to comply with technical specification stipulations |
| 23 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 144 | Page 59 of 60 | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br>The absorber oxidation tank, absorber tower & absorber outlet duct up to absorber outlet flange shall be provided with 2 mm (minimum) thickness lining / cladding / Alloy C276 / Alloy 59 or better material. | Based on the referred amendment, bidder understands that the following options are available for the biders for selection:<br>1) Lining as an alternate to cladded sheet for entire absorber with 2 mm (minimum) thickness<br>2) Material of lining/cladding shall be Alloy C276 / Alloy 59 / better material as per proven practice of the bidder | It is clarified that only cladded plate of Alloy C276/ Alloy 59 or better material with Carbon steel base is allowed. Cladded plate can be manufactured by either rolling or explosion bonding process. |
| 24 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 142 | Page 59 of 60 | 2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type / positive displacement (Helical lobe) type with VFD drive, oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower will be used for supplying a variable volume of air to the absorber reaction tank. | Bidder offers Jet Bubbling Technology, wherein oxidation air flow is significantly higher at lower pressure and is also contrary to what is being provided for spray tower / conventional FGD systems. Owing to the lower pressure & high flow requirement, we request you to also introduce option of centrifugal fan with VFD for JBR. Hence request you to modify the specification as below:<br>2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type oxidation blower / centrifugal fan with VFD drive / positive displacement (Helical lobe) type oxidation blower with VFD drive, oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower / fan will be used for supplying a variable volume of air to the absorber reaction tank. | VFD for positive displacement (helical lobe) type oxidation blower is mandatory, however, for centrifugal type blower it is optional. |
| 25 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 2 | 1 of 60 | Existing:<br>Clause no. 1.01.01, ….. , 2.07.00 | Bidder understands that indicated Cl.No.2.07.00 instead refers to Cl.No.1.07.00 of existing specification Section VI-A Sub-section-VII Cl.No.1.25.00.<br>Kindly confirm / clarify. | Bidder's understanding is correct. |
| 26 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 95 | 34 of 60 | Limestone handling through road only | Bidder understands that considering Limestone handling through road only, no interface is envisaged between FGD system and CHP system. Accordingly, hardwired interface of Bidder's FGD DDCMIS and Employer's CHP DDCMIS shall not be applicable.<br>Kindly confirm / clarify. | Bidder's understanding is correct in view of limestone handling through road only. |
| 27 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 10.01.00 | 16 of 19 | Hardwired Signal exchange: Hardwired signal exchange between BOP DDCMIS / CHP DDCMIS (under Employer's scope) and FGD DDCMIS (under Contractor's scope)… | | |
| 28 | CS-0011-109(1A)-2-AMDT-05(T), Mech Annex-VI, Sub-section-IIIA-1, FGD | 1.06.00 | 1 of 1 | (for Barh-1 (3 X 660 MW))<br>CEMS system shall be provided by the contractor in existing chimney as specified for other projects for new chimney in common specification. | (a) Bidder understands that for Barh-1 project CEMS, only Oxygen analyser shall be included in Bidder's scope. Kindly confirm / clarify.<br><br>(b) Bidder understands that accordingly only Notes-3 & 8 of C&I Annexure-VIII Cl.No.3.03.01 shall be applicable for Barh-I. Kindly confirm / clarify. | (a) Bidder's understanding is not correct. It is clarified that Oxygen measurement in stack, Mercury in stack emission and flue gas flow at stack are in the contractor's scope of supply for BARH-I project.<br><br>(b) It is clarified that Notes 3, 4, 6, 7, 8, and 9 of clause 3.03.01, PART-A, Subsection IIIC are applicable for BARH-I projects. |
| 29 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 3.03.01, | 12 of 19 | Notes-9:<br>Analyzers mentioned in S.No. 1 to 5 of the above list of flue gas analyzers for CEMS are not applicable for BARH-I project. However, Oxygen (O2) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for BARH-I project for correction of SO2, NOx and Particulate matter value corresponding to the standard/reference O2. | | |

# Lot1A Flue Gas Desulpurization Package
## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 30 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-I, VI-B, Sub-section-III-C2, Measuring Instruments | 10.01.00 | 1 of 13 | ANALYSER INSTRUMENTS (OTHER THAN CEMS)<br>....<br>Note: Analysers shall be placed inside CONTAINERISED ROOM (PORTABLE CABIN) provided by the contactor. | Bidder understands -<br><br>(a) Analysers with air conditioning is envisaged only for Extractive (Hot-extractive/Dilution type) type Flue gas analysers. Kindly confirm / clarify.<br><br>(b) Extractive (Hot-extractive/Dilution type) analysers requiring air conditioning shall be provided with Panel AC or kept in AC room / Portable Cabin, to meet analyser requirement. Kindly confirm / clarify. | Bidder's understanding is not correct. Pl refer clause no.3.02.00, Sub section III-C, PART-A, "Scope of supply and services" wherein it is mentioned that all weather analyser panel located in air conditioned containerised room (Portable cabin) shall be provided for housing analysers except In situ analysers. |
| 31 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-I, VI-B, Sub-section-III-C2, Measuring Instruments | 11.00.00 (viii) | 5 of 13 | CEMS analysers shall be placed inside CONTAINERISED ROOM (PORTABLE CABIN) provided by the contactor. .... | | |
| 32 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-I, VI-B, Sub-section-III-C2, Measuring Instruments | 11.07.00, Notes (03) | 13 of 13 | If the SOx, NOx, CO2 & CO ( if sampling/dilution type) analyzers do not meet the environmental conditions specified at cl. 7.00.00 of Sub Sec IIIC-01, Section-VI, Part- B, all weather Local Panel fitted with integral Air Conditioner located in non-air conditioned area shall be provided for housing analysers etc. | | |
| 33 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 3.02.00 | 10 of 19 | All weather analyser panel located in air conditioned containerised room (Portable cabin) shall be provided for housing analysers except In situ analysers. | | |
| 34 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-II, Part-A, Sub-section-VII, Mandatory Spares, 1.25.00 | 1.03.00A (i) | 3 of 6 | Analysers and associated items for other than CEMS:<br>(i) Analysers for SO2, O2, pH - 1 no. complete analyser of each type and model. | Bidder understands that as per Tender Specification, O2 analysers are envisaged only for CEMS. Accordingly mandatory spares for O2 analyser for other than CEMS, shall not be applicable.<br>Kindly confirm / clarify. | It is clarifed that mandatory spare for O2 analyser (other than that envisaged under CEMS) shall be applicable in case the O2 analyser is supplied for any FGD application other than CEMS. The same shall be discussed and decided during detailed engineering. |
| 35 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-II, Part-A, Sub-section-VII, Mandatory Spares, 1.25.00 | 2.07.00, 1(E) | 4 of 6 | Other HMIPIS devices required for Unified HMIPIS which are not covered in above items like protocol converters, stations with software, gateway etc - 10% of each type and model | Bidder understands that Unified HMIPIS and mandatory spares for the same, is not applicable for the FGD DDCMIS. Kindly confirm / clarify. | Bidder's understanding is correct. |
| 36 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-II, Part-A, Sub-section-VII, Mandatory Spares, 1.25.00 | 2.07.00, 4 | 5 of 6 | Electronic modules of each type and model for .... Master and Slave Clock etc.... | Bidder understands that mandatory spares for Master and Slave Clock is not included in Bidder's scope.<br>Kindly confirm / clarify. | Bidder's understanding is correct. |
| 37 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VI, VI-B, Sub-section-IIIC-05, DDCMIS | 1.06.06 | 3 of 23 | DDCMIS shall meet all requirements stipulated under other Sub-sections/sections of the specification including Sub-Section-IIIC, Part-A, (including the requirement Authorization to shipment test ATST) Quality assurance (Part B, Section VI of technical specifications) & General Technical Requirements (Part C Section VI of Technical Specifications). | Bidder is unable to find DDCMIS ATST/Quality assurance requirements & availability calculation procedure in referred sections.<br>Employer to kindly clarify. | Bidder to refer clause 2.12.00, PART-A Sub section IIIC for ATST requirement. Further ATST prodecure shall be approved by employer during detailed engineering.<br><br>Bidder to refer Part-B, Sub section V for Quality assurance requirement.<br><br>The availability calculation/test procedure shall be approved by employer during detailed engineering. |
| 38 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VI, VI-B, Sub-section-IIIC-05, DDCMIS | 12.06.00 | 22 of 23 | The availability of system shall be calculated as per Sub-section-IV, Part-A, Section-VI of specifications. | | |

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## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 39 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VI, VI-B, Sub-section-IIIC-05, DDCMIS | 3.01.02 | 5 of 23 | FIELDBUS ((Foundation Fieldbus/ Profibus) Interface<br>....<br>Redundant host/ master card and redundant power supply along with diagnostic module shall be provided | Bidder understands that redundancy of host / master and power supply is envisaged only for segments with critical measurements / controls.<br>Kindly confirm / clarify. | Bidder's understanding is not correct. It is clarified that Redundant host/ master card and redundant power supply along with diagnostic module shall be provided for all segements. |
| 40 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VI, VI-B, Sub-section-IIIC-05, DDCMIS | 3.06.00 | 8 of 23 | Remote input/output modules may be located in harsh environment, the modules shall be designed in such a way to work continuously under the harsh environment expected to be encountered in these areas (high temp, dust level, humidity etc.). | Bidder understands that as per Annexure-VIII, VI-A, Sub-section-IIIC (C&I), Remote I/O cabinets shall be placed in air conditioning environment. Accordingly I/O modules of Remote I/O cabinets are not envisaged for continuous operation in harsh environment.<br>Kindly confirm / clarify. | Bidder to refer clause 4.01.00, PART-B Sub section III-C1, wherein it is mentioned that Instruments, devices and equipments for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated in the table and shall be suitable for continuous operation in the operating environment of a coal fired utility station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification. Bidder to comply with the specification requirement mentioned in the above clause for Remote input/output modules. |
| 41 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 2.02.04 | 4 of 19 | Contractor shall place RIO cabinets inside building with air conditioning environment. | | |
| 41 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 1.02.01 | 2 of 19 | Fieldbus based control system for fieldbus based actuators and fieldbus based instruments (PT/DPT/TT) shall be provided for all applications. In case non fieldbus based actuator or transmitters are required for few applications then the same shall be discussed and finalized during detailed engineering. | Employer to kindly clarify the applications for which non-fieldbus type MOVs or transmitters (PT/DP/TT) are envisaged. | The applications for which non-fieldbus type MOVs or transmitters (PT/DP/TT) are envisaged shall be finalised during detailed engineering after discussion with FGD OEM. |
| 42 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 2.02.00 | 3 of 19 | ….The Control System of FGD DDCMIS has following process blocks as minimum. Any other systems apart from the below mentioned systems shall be included in the common system. | Bidder understands that common systems like Fire protection system shall be controlled from the FGD DDCMIS Common system process block, and no dedicated PLC is envisaged for the same.<br>Accordingly, Employer to kindly clarify the requirement of mandatory spares for PLC Control system & 24VDC supply system for Fire Protection system. | Noted. However, the same shall be discussed and decided during detailed enginerring. |
| | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-II, Part-A, Sub-section-VII, Mandatory Spares | 1.22 | 6 of 6 | FIRE DETECTION AND PROTECTION<br>....<br>7.5) PLC CONTROL SYSTEM<br>....<br>7.6) 24V – DC POWER SUPPLY SYSTEM<br>.... | | |
| 43 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 2.02.01 | 4 of 19 | (b) Common system process blocks:<br>i. Gypsum De watering Handling common system block<br>ii. Lime stone preparation and handling common system block.<br>iii. Other associated common system. | Bidder understands that a Common process block is envisaged including all common systems like Gypsum dewatering & handling, Limestone handling, Limestone Slurry preparation and other common systems.<br>Kindly confirm / clarify. | It is clarified that three Common system process blocks are envisaged as mentioned below:<br>i. Gypsum De watering Handling common system block<br>ii. Lime stone preparation and handling common system block.<br>iii. Other associated common system. |
| 44 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 2.10 (b) | 7 of 19 | Marshalling cabinets separate from system cabinets for terminating inputs from field, MCC/SWGR etc., for further wiring to control system and for terminating outputs from control system to MCC/SWGR etc. | Bidder understands marshalling may be provided on the rear side of system cabinet or as separate cabinets, as per Control System OEM's recommendation.<br>Kindly confirm / clarify. | The same shall be discussed and decided during detailed engineering. |
| | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 2.10 (e) | 7 of 19 | In case DDCMIS supplier can provide system cabinet with suitable partition to create separate marshalling area on the rear side of the system cabinet, ensuring that dust ingression does not take place in system area, the same can also be accepted subject to Employer's approval during detailed engineering stage | | |

# Lot1A Flue Gas Desulpurization Package
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| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 45 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VIII, VI-A, Sub-section-IIIC (C&I) | 2.15.00 | 9 of 19 | Output redundancy is applicable for 10% of drives distributed in various functional groups. Exact application shall be finalized during detailed engineering. | Bidder understands output redundancy shall be applicable for 10% process drives only, not including MOVs, Pneumatic On/Off / Control valves, Electrical breakers etc.<br>Kindly confirm / clarify. | It is clarified that Output redundancy is applicable for 10% of drives including MOVs, Pneumatic On/Off / Control valves, Electrical breakers etc., distributed in various functional groups. |
| 46 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 46 | Page 16 of 60 | For Barh-I (3X660MW) already existing 275m high chimneys shall be utilized with modifications as specified elsewhere in mechanical specification and hence, new chimney is not to be provided under FGD package. General Arrangement Drawing of already existing Chimneys at Barh-I are provided in Sub Section-II -A10, Part A, Section-VI for reference. | Bidder understands that existing chimney in BARH-I is equipped with Earthing and Lightning Protection, Aviation Lightings and all other lightings and its accessories (Platform & staircase).Hence bidder shall not consider the same in its scope of supply.<br>NTPC is requested to confirm. | Bidder understanding is correct. |
| 47 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.no. 21 | Page 8 of 60 | Termination….. (Tender drg. No 0000-211-POE–A-51-RA of cable lug attached at the<br>end of this chapter.) Tender drawing attached as Electrical Annexure E3- 0000-211-POE–A-51-RA. | Bidder understands that conductor size HT Power cables ( to be 95sqmm, 150 Sqmm and 300 sq mm) mentioned in the drawing is just for reference. Also, Tender has not indicated any standard cable sizes for HT cables. Bidder can use any size of HT Cable apart from the sizes mentioned in this drawing. | Bidder's understanding is clear. However, Bidder to meet sizing criteria clause no 2.16.00 of Sub Sec E7, HT Cable of tech spec. |
| | Electrical annexure-E3 | | Page 16 of 19 | Typical drawing for cable lug | | |
| 48 | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VII, part-B,Sub-section-IIIC-10 POWER SUPPLY | 1.04.00 | 3 OF 7 | Battery Health Monitoring System (BHMS) | As per the confirmation received to clarification Sr. no. 829 in DOC no. CS-0011-109(1A)-2-CLRF-TECH-01, page:374 of 736, Bidder understand that Battery health monitoing system shall not be applicable to FGD package. Please confirm the understanding wrt clarification reply. | Bidder's understanding is not correct. It is clarified that as per clause 1.00.00 and 1.05.00, part-B, Sub-section-IIIC-10, POWER SUPPLY, BHMS for 24V DC power supply and UPS is in the scope of contractor. The referred clarification (Sr. no. 829 in DOC no. CS-0011-109(1A)-2-CLRF-TECH-01, page:374 of 736) pertains to BHMS of main plant 220V DC system mentioned under Electrical section of technical specification. |
| | CS-0011-109(1A)-2-AMDT-05(T), C&I Anneuxure-VII, part-B,Sub-section-IIIC-10 POWER SUPPLY | 1.05.00 | 4 OF 7 | UPS system shall consist of 1 x 100% charger and inverter with input isolation<br>transformer, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories. | | |
| 49 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 144 | 59 of 60 | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br>The absorber oxidation tank, absorber tower & absorber outlet duct up to absorber outlet flange shall be provided with 2 mm (minimum) thickness lining / cladding / Alloy C276 / Alloy 59 or better material. | Since, as per the amendment, option of either **lining** or **cladding** of Alloy C276 / Alloy 59 is provided, NTPC is requested to clarify whether application method (e.g. wall papering) other than cladding can also be considered.<br>Also, the requirement *"2 mm (minimum) thickness lining / cladding / Alloy C276 / Alloy 59 or better material"* is read as *"2 mm (minimum) thickness lining / cladding* ***of*** *Alloy C276 / Alloy 59 or better material"*. NTPC to confirm. | It is clarified that only cladded plate of Alloy C276/ Alloy 59 or better material with Carbon steel base is allowed. Cladded plate can be manufactured by either rolling or explosion bonding process. |
| 50 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 46 | 17 of 60 | For Barh-I (3X660MW) already existing 275m high chimneys shall be utilized with modifications as specified elsewhere in mechanical specification and hence, new chimney is not to be provided under FGD package. General Arrangement Drawing of already existing Chimneys at Barh-I are provided in Sub Section-II -A10, Part A, Section-VI for reference. | Since, existing chimney is to be used for Barh-I project, Bidder understands that the flue gas velocity limit of <18 m/s (at Design point) for chimney is not applicable for this project. NTPC to confirm.<br>Further, NTPC is requested to inform the draft loss and flue gas velocity in the existing duct (downstream of absorber outlet tap-off point) and chimney. | Bidder understanding on velocity in chimney is correct. For draft loss, consider pressure drop of 40 mm through chimney or actual whichever is higher. Velocity inside the duct and chimney can be calculated based on the FGD flow at the absorber outlet. |
| | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | 119 | 47 of 60 | ……..<18 at Design Point | | |

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| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 51 | CS-0011-109(1A)-2-AMDT-05(T) | 46 | 17 of 60 | Single-flue chimney(s) shall be provided, **except for Tanda TPP (2X660MW) and Meja TPP (2X660MW) where twin-flue Chimney shall be provided.** Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point for single flue chimney shall be minimum 150 meters above the plant grade level and for twin flue chimney flue gas emission point shall be minimum 220m above the plant grade level. | Bidder understands that single flue chimney is also acceptable where twin flue chimney is mentioned. NTPC to Confirm. | Bidders understanding is correct. |
| 52 | CS-0011-109(1A)-2-AMDT-05(T) | 123 | 49 of 60 | In order to optimise power consumption of FGD system at part load operation, Bidder to provide atleast one slurry recirculation pump preferably lower level with Variable Frequency Drive (VFD). | Bidder understands that gearbox is not required to be provided for the recirculation pump with variable frequency drive. NTPC to confirm. | Bidder may decide for gearbox in case recirculation pump is with variable frequency drive. |
| 53 | CS-0011-109(1A)-2-AMDT-05(T) | 123 | 49 of 60 | In order to optimise power consumption of FGD system at part load operation, Bidder to provide atleast one slurry recirculation pump preferably lower level with Variable Frequency Drive (VFD). | **NTPC to advise for the following:**<br>For Nabinagar -4x 250MW unit the Motor rating for SRC (Slurry Recirculation Pumps) pumps will be approx 550 KW and as per latest amendment bottom level of pump motor will be with VFD of 690 V as per VFD specification, and all other remaining level motors will be with 3 phase 6.6 KV AC motor as per original tender specification,which makes different voltage levels for different levels of SRC pumps motor (i.e Bottom level SRC pump motor with 690V LT and other level motors with 6.6 KV HT).<br>Since the voltage levels for SRC pump motors are different, this will violate the NTPC specification of (As per Clause no-5.01.00 (iii) of Sub Section-I-M1 of Section-VI) "All slurry recirculation pumps including motors shall be of the same size and type." | All slurry recirculation pumps including motors shall be of the same size and type execpt for VFD driven SRC pump-motor set. |
| 54 | CS-0011-109(1A)-2-AMDT-05(T) | Electrical Annexure-E2 | Clause no-3.03.00 | The voltage level for the VFD output to be fed to motor shall be as follows:-<br>1. Upto 400 kW : 415V/690V, Low Voltage, Three Phase AC<br>2. **Above 400kW and upto 700 KW : 690V, Low Voltage, Three Phase AC**<br>3. Above 700KW : Medium Voltage | | |
| 55 | CS-0011-109(1A)-2-AMDT-05(T) | 142 [c] | 54 of 60 | 2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type / **positive displacement (Helical lobe) type with VFD drive**, oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower will be used for supplying a variable volume of air to the absorber reaction tank. | NTPC to clarify whether VFD is required only for Positive Displacement type blowers or both Positivive Displacement Blowers and Centrifugal type blowers. | VFD for positive displacement (helical lobe) type oxidation blower is mandatory, however, for centrifugal type it is optional. |

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## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 56 | CS-0011-109(1A)-2-AMDT-05(T) | 63 | 25 of 60 | **General Layout Plan**<br>1. Kudgi (3x800 MW) 9573-999-POC-F-001 Rev.8 (Civil Annex 6)<br>2. Lara (2x800 MW) 9548-999-POM-F-001 Rev.9 (Civil Annex 7)<br>3. Gadarwara (2x800 MW) 9572-999-POC-F-001 Rev.7 (Civil Annex 8)<br>4. Darlipali (2x800 MW) 9549-999-POC-F-001 Rev.11 (Civil Annex 9)<br>5. Mouda (2x660 MW) 9561/9575-999-POC-F-001 Rev.12 (Civil Annex 10)<br>6. Solapur (2x660 MW) 9571-999-POC-F-001 Rev.6 (Civil Annex 11)<br>7. Tanda (2x660 MW)9562-999-POC-F-002 Rev.10 (Civil Annex 12)<br>8. Nabinagar JV (3x660 MW) 0370-999-PO-F-001 Rev.11 (Civil Annex 13)<br>9. Meja (2x660 MW) 0360/0361-999-POC-F-001 Rev.8 (Civil Annex 14)<br>10. Barh (3x660 MW) 9558/9560-999-POC-F-001 Rev.9 (Civil Annex 15)<br>11. Nabinagar (4x250MW) 0270-999-POC-F-001 Rev. 9 (Civil Annex 16) | NTPC is requested to provide the Autocad format for the GLP (General Layout plan). | All GLP in pdf format already provided. |
| 57 | CS-0011-109(1A)-2-AMDT-05(T) | 101 | 39 of 60 | Suitable number of motorized travelling tripper / flow diverter plough (as applicable)<br>on each feeding conveyor for feeding the crushed limestone to the covered storage<br>shed/Silo. Trippers shall be complete with all mechanical, electrical equipment, rails,<br>chute work, rail supporting structure (along with structural stools, as required), cables<br>with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator<br>flap gates etc. | Considering the 150 TPH capacity and layout ,Bidder recommends Reversible Belt feeder / Diverter type Y-Chute to feed the Limestone in to limestone bunkers which is more suitable than Fixed tripper / Plough arrangement for one day storage silo. | Bidder to comply with technical specification stipulations |
| 58 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T), Sl. No.-106, page-40 of 60 | | | The absorber oxidation tank, absorber tower & absorber outlet duct up to absorber outlet flange shall be provided with 2 mm (minimum) thickness lining / cladding / Alloy C276 / Alloy 59 or better material. | Based on Amendment No. 3 dtd. 02-11-2017, we have submitted Techno-commercial offer considering Clad Steel for complete Absorber vessel. However, based on recent Amendment, we understand that Bidder is allowed to choose either lining or Cladding of 2mm thick C-276 / Alloy 59 for submission of Price Bid. Request NTPC to confirm the same. | It is clarified that only cladded plate of Alloy C276/ Alloy 59 or better material with Carbon steel base is allowed. Cladded plate can be manufactured by either rolling or explosion bonding process. |
| | | | | | Bidder understands that 5 m3/hr capacity of condensate storage tank in common to be provided irrespective of no of units.<br>Request NTPC to confirm the same. | Bidder's understanding is correct. |
| 59 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T), Sl. No.-46, page-16 of 60 | | | Single-flue chimney(s) shall be provided,<br>except for Tanda TPP (2X660MW) and<br>Meja TPP (2X660MW) where twin-flue Chimney shall be provided. Chimney shall<br>be of reinforced concrete construction.<br>There shall be one flue (liner) for each unit.<br>The flue gas emission point for single<br>flue chimney shall be minimum 150 meters<br>above the plant grade level and for twin<br>flue chimney flue gas emission point<br>shall be minimum 220m above the plant<br>grade level.<br>The centre to centre distance between the<br>proposed chimney(s) and the existing<br>chimney(s) in any direction shall not be less<br>than 150 metres.<br>**For Barh-I (3X660MW) already existing 275m high chimneys shall be utilized with modifications as specified elsewhere in mechanical specification and hence, new chimney is not to be provided under FGD package. General Arrangement Drawing of already existing Chimneys at Barh-I are provided in Sub Section-II -A10, Part A, Section-VI for reference.** | For Barh-I PJ, Bidder understands only stack lining & condensate collection system will be provided by bidder. Bidder is considering common condensate storage tank with capacity of 5 m3/hr catering to all the Three Units stack.<br><br>Also, desing conditions of flue gas exiting the stack need to be provided as Condensate study is inlcuded in bidders scope.<br><br>Request NTPC to confirm & provide the same. | Bidder's understanding is correct. Additional details shall be provided during detail engineering. |

# Lot1A Flue Gas Desulpurization Package
## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 60 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T), Sl. No.-142, page-57 of 60 | | | Following note is added.<br>Note:-<br>3.For the purpose of sizing of equipments and guarantee, MgCO3 shall be considered as unreactive dolomitic form. | NTPC to clarify the procedure for measuring the limestone consumption for such cases i.e without considering the reactivity of MgCO3 at the time of Performance Guarantee Test. | Limestone consumption gurantee shall be based on available **(Reactive)** CaCO3 content of 89%, reactive CaCO3 content of 79% for sizing. This is already specified in Clause no. 6.00.00 Note, Sub Section V of Section VI, Part A . Impact of non reactive MgCO3 is already considered in the % of CaCO3.(89%). In view of this, there is no need to consider again impact of unreactive MgCO3 dolomitic form for gurantee and sizing of equipment. |
| 61 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No.142 | 57 of 60 | Following note is added.<br>Note:-<br>3.For the purpose of sizing of equipments and guarantee, MgCO3 shall be considered as unreactive dolomitic form | Noted this point in amendment. However Bid doesn't have any mention about Limestone reactivity, which is considered as one of the major characteristic parameter for the system design & performance guarantees:<br><br>It can be understood that even the limestone samples with highest purity level will have different reaction times. Some sample may not be fit for the FGD application itself, hence the reactivity parameter has to be specified in bid document for the mutual benefit.<br><br>The same was discussed during the **technical meeting held on 4 & 5th April 2018** & We are requesting Client to clarify on this point and issue the suitable amendment. | Limestone consumption gurantee shall be based on available (Reactive) CaCO3 content of 89%. This is already specified in Clause no. 6.00.00 Note, Sub Section V of Section VI, Part A |
| 62 | | | | | Proposaed Text for Amendment on "Limestone reactivity"<br>Reactivity has to be measured according to VGB M.701 or EPRI standard. We kindly ask NTPC Ltd to consider this in the amendment, as we have requested on this topic through emails & discussion in NTPC office.<br>Based on the specified test procedure we request the following conversion rates/relativities for the used limestone:<br>1. Conversion rate of limestone after 5 min > 39 %<br>2. Conversion rate of limestone after 10 min > 47 %<br>3. Conversion rate of limestone after 30 min > 65 %<br><br>This specification will guarantee that the limestone is suitable for the FGD application.<br><br>**<u>Atleast the below point shall be agreed by Client:</u>**<br><br>**"The limestone quality provided by Client will be suitable for Limestone Wet FGD Operation "** | |
| 63 | | | | | **The email dated 9th April to NTPC:** On April 4th we have sent you our first results from our R&D project where we are testing different limestone samples from India. The diagram shows first results from limestone mines in Gujarat and Rajasthan.<br>The colored lines shows the reactivity (conversion rate) curve of the tested limestone samples, the full line in black shows the lower and upper limit of our reference limestone. (We have tested numerous samples of the reference limestone and found results in the band between this 2 curves) Any reactivity curve from a tested limestone which is fully above the lower black line represents a suitable limestone and of course also any reactivity curve which is above the upper black line is suitable as it shows an even better reactivity. So based on this analyses the LAB 3078-1 limestone sample is by sure not suitable, we got it from a mine in the Gujarat state. There are 2 more samples LAB 3078-14, LAB 3078-16 which show a lower as requested reactivity in the first 500 sec; these results are under further investigation<br><br>The VGB method as well as the EPRI method define the analysis procedure of the limestone reactivity measurement. In none of these methods a reference curve – showing the min necessary reactivity - is specified. The reference curves are always based on the Know How and the experience of the FGD supplier, meaning that each FGD supplier should have his own requirement to the reactivity of the limestone. Usually the employer defines the requested limestone reactivity towards the limestone supplier and shows this specification also in the tender documents. Based on this and based on the result of our limestone reactivity tests we have proposed the wording for the amendment. I am convinced that any FGD supplier will be happy to see this definition and would be able to accept this definition | |

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| 64 | SUB-SECT10N·I·M1 - Part B | 5.06.13 | 19 of 51 | All internal members shall be lined with minimum 2 mm Alloy 59/ C276 . All metallic fasteners which are provided inside the absorber/absorber wet-dry interface ducting shall be of Alloy 59/ C276. | With reference to the material of construction of the FGD Plus layer, we would like to highlight the following additional points for you kind consideration **(please also consider our E mail sent on April 5th and 7th 2018)**<br>We fully understand your concern for the temperature issue. But we have successfully installed the FGD plus layer in our plants, which are in operation without any issues.<br>We are intending to use PP material, as C276 is not suitable for the FGD plus layer. It is a choice purely by technicality and our patent is also for this material.<br>As you are aware that the Polypropylene (PP) is basically a plugging resistant material, which is quite resistant to chemical reaction and binding with the scale that forms due to slurry in the FGD system. Thus, the formation of scale is slowed and the scale does not bind with the surface. Therefore, the scale can be easily removed. Since this module is located at the bottom of the spray level, this module gets automatically flushed with recirculation slurry. The slurry tends to coat onto the Alloy/C 276 material due to surface interactions between the slurry and Alloy/C 276 surface microstructure. It scale up faster and worse – the scale reacts with the material forming a strong bond between scale and material. This affinity towards scale formation is a hindrance to the performance of FGD plus module and become almost impractical without PP material. Any change in material of construction to C276 cannot meet the desired performance.<br>Please note that there are several other components in FGD Absorber too, which are also not lined with Alloy C276 due to functional requirement.<br>• Mist eliminator (PS)<br>• Spray headers (FRP)<br>• Spray nozzles (SiC)<br>• Oxidation lance inside slurry sump (FRP)<br>• Strainers inside slurry sump (PP)<br>Still, these component would provide the desired performance and life. In the similar lines, the material of construction of FGD plus component too, have been selected to give the desired performance without compromising on the desired corrosion resistance.<br>However, the supporting structure of FGD plus layer will be made of carbon steel with Alloy lining as per Tender requirements.<br>We kindly request NTPC to accept our design. We confirm the FGDplus system will give excellent performance and will provide excellent resistance against erosion and corrosion. We request Client to confirm on this point. | This is not clarification. Hence, bidder is requested to comply. |
| 65 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.No.-114 | 44 of 60 | The complete frame of the filter and all parts in contact with gypsum shall be made with corrosion resistant material. | During NTPC technical meeting, we have requested Client to include corossion resitant coating such as plastic coats over the Mildsteel frames of filter. So kindly confirm on the same. | This is not clarification. Hence, bidder is requested to comply. |
| 66 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl.No.-46 | 17 of 60 | For Barh-I (3X660MW) already existing 275m high chimneys shall be utilized with modifications as specified elsewhere in mechanical specification and hence, new chimney is not to be provided under FGD package. General Arrangement Drawing of already existing Chimneys at Barh-I are provided in Sub Section-II -A10, Part A, Section-VI for reference. | Client to mention the fluegas pressure (mmWC) available at terminal point (Downstream of booster fan) at Existing ID fan duct to Existing stack. This is required for sizing the booster fan for Barh Project. | Bidder understanding on velocity in chimney is correct. For draft loss, consider pressure drop of 40 mm through chimney or actual whichever is higher. Velocity inside the duct and chimney can be calculated based on the FGD flow at the absorber outlet. |
| 67 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Point no-46 | 16 of 60 | Single-flue chimney(s) shall be provided, except for Tanda TPP (2X660MW) and Meja TPP (2X660MW) where twin-flue Chimney shall be provided. Chimney shall be of reinforced concrete construction. | Noted for Tanda (2x660 MW);<br><br>For **MEJA (2x660 MW) :** Within the available spaces allocated as per GLP provided in amendment, the TWIN stack arrangement cannot be accomodated. Whereas the area provided near Coal stock pile (very far from existing chimney) will increase the duct length substantially , also has to cross the railway tracks and this is not a recommended design. Hence kindly allow us to **proceed with single wet stack option.** Kindly confirm. | For Meja & Tanda, both the option of Single & twin flue is allowed. |
| 68 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Point no-95 | 34 of 60 | Limestone will be received to power plant through road by truck. | 1) Considering this amendment, we are providing 150TPH conveying sysetm along with rated capcity of 150TPH for Crusher, screen & bucket elevator.Kindly confirm. | Bidder's understanding is correct. |

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| 69 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Point no 102 | 39 of 60 | Double conveyor.....inside a closed storage shed preferbly near plant boundary... | As per our arragement we have considered storing of Gypsum insider closed shed below i.e below the vacuum belt filter area. Locating near plant boundary is not possible and difficult for conveying.. Kindly confirm. | Amendment / Technical specifications are clear in this regard.<br>Bidder may locate the Gypsum storage shed duly considering layout constraints and technical specification stipulations. |
| 70 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Point no 98 | 37 of 60 | Dust extraction system<br>Type: Bag Filter type<br>Location: Truck un-loading points, Junction Towers (limestone/ gypsum discharge & receipt points), limestone crusher house (including belt feeder & vibrating screening feeder) and lime stone/gypsum storage Shed/Silo. | Dust extraction for Truck unloading points & Limestone and Gypsum storage shed cannot be provided as it will be open area.<br><br>Plain water Dust suppression can be provided for Truck unloading points and for Trippers at Shed can be provided with Trolley mounted Dust suppression system. Kindly confirm. | Bidder to comply with technical specification stipulations. |
| 71 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Point no 95 | 35 of 60 | Lime stone received through Road shall be unloaded by Two (2) numbers Truck Tipplers each of minimum 40T capacity (Gross weight 60 T minimum) to discharge Limestone on to Box Feeder/ Surface Feeder/ Truck Unloading Hopper | Please confirm whether any shed has to be considered for Truck Unloading hopper. | Confirmed |
| 72 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 140 | 56 of 60 | Barh-1 (existing chimney) | As per the amendment Barh will not have any provision of new chimeny. The existing chimney is required to be lined.<br><br>NTPC to specify the estimated unit outage provision for chimney lining. | Barh units are under construction and hence shutdown will not be required for Chimney lining. Further, bidder to complete chimney lining work as per schedule indicated in BDS. |
| 73 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 100 | 38 of 60 | Bucket Elevator | We are considering bucket elevator for conveying limestone from Crusher output to Limestone storage silo and from lime stone storage silo to lime stone day silo.<br>The rated capacity of both the bucket elevator and belt conveyor feeding to crusher house from the truck tippler/box feeder shall be 150 TPH. | Bidder understanding is in order regarding capacity of Bucket elevator / Belt conveyor. |
| 74 | General | General | | Discussion on Layout | We propose to have a final discussion to freeze the layouts.<br><br>As the lime stone unloading provission has been changed, all the layouts will go for a major change. | NTPC has already indicated blocks for FGD installation. Detailed discussion already carried out and explained the NTPC specification requirement. Bidder to finalise their Layout meeting the specification requirement. |
| 75 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 63 | 25 of 60 | Lara (2x800 MW)<br>9548-999-POM-F-001 Rev.9 (Civil Annex 7) | The space indicated in the GLP is inadequate for installation of FGD system. The following additional space is proposed for FGD system-<br>> S 2000 to 2300 & E 325 to 375<br><br>NTPC to review and confirm. | Requested additional area shall be provided for FGD facilities. |
| 76 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 63 | 25 of 60 | Gadarwara (2x800 MW)<br>9572-999-POC-F-001 Rev.7 (Civil Annex 8) | The space indicated in the GLP is inadequate for installation of FGD system. The following additional space is proposed for FGD system-<br>> N 17080 to 17140 & E 17000 to 17100<br><br>NTPC to review and confirm. | Bidder to accommodate their FGD facilities within allocated space shown in Amendment No. 5 GLP . |
| 77 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 63 | 25 of 60 | Tanda (2x660 MW) 9562-999-POC-F-002 Rev.10 (Civil Annex 12) | The space indicated in the GLP is inadequate for installation of FGD system. The following additional space is proposed for FGD system-<br>> N 900 to 1100 & W 200 to 400<br><br>NTPC to review and confirm. | Area enclosed between Conv 3A/3B, cable trestle for CHP and East side of raw water pipe line may be used for FGD facilities. However, it is to be noted that this area may not be required as area already allocated is sufficient to accomodate FGD facilities. |
| 78 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 65 | Page 27/60 | New Clause:<br>Bidder shall utilize the area identified for FGD purpose. The area identified for FGD purpose in GLP shall be levelled and free from obstructions like sheds, trees etc. However, site clearance like removal of bushes, vegetation etc. is in Bidder's scope. | 1) Bidder understands that the Site levelling is in Owner's scope.<br>2) Bidder understands the cutting of bushes & trees are in bidder's scope but the taking the necessary approval shall be in Owner's scope<br>3) Bidder understand that the owner shall provide the necessary land for FGD which will be free from obstructions( above & below the ground) | It is clarified that area identified for FGD purpose in GLP shall be levelled and free from obstructions like sheds, trees etc and will be in Owner;s scope, However, site clearance like removal of bushes, vegetation etc. is in Bidder's scope. Bidder to refer specification wrt facilities underground. |

# Lot1A Flue Gas Desulpurization Package
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| 79 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 90 | Page 32/60 | Piping for normal ----------, piping for emergency ---------pump, other piping, fittings, supports, valves and specialties…….and structural steel shed for housing various equipment of Equipment cooling water system | 1) Bidder understands that bidder can place other pumps along with the ECW equipment under the same shed.<br>2) ECW shed shall be open on all four sides, only roof will be provided with sheeting.<br>3) So Ventilation will not be considered for this shed. | Ventilation is not required for shed. Further, shed is to be provided along with roof sheet as per specification requirement. |
| 80 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 109 | Page 42/60 | Gypsum Dewatering System & FGD control room. Slurry re-circulating pumps & Oxidation blowers shall be located in a shed provided with roof sheeting. | a) Bidder understands that only roof sheeting will be provided, no side sheeting required.<br>b) So ventilation shall not be considered. | Ventilation is not required for shed. Further, shed is to be provided along with roof sheet as per specification requirement. |
| 81 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 142 b | Page 58/60 | As per Amendment:<br>Bidder should provide the condensate collection system such that the condensate collected shall be routed to absorber by gravity,…..<br>common storage tank for the both the units of storage capacity of 5 m3/hr of stack condensate of both the stack shall…. | 1) Bidder understands the storage capacity shall be 5 m3.for the common tank (for 2 units).<br><br>2) Please confirm what will be the capacity of the tank for 3rd unit (in case of three units) shall be. | Capacity shall be same for two/three units. Min 5m3/hr. |
| 82 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 18 | 7 OF 60 | ….Gypsum Dewatering system & FGD common control room & containerised room (portable cabin) for analysers. The buildings must be complete…… | Bidder proposes to use combined ball mill and dewatering building in plants where space/layout is a challenge. Bidder requests employer to confirm the same. | We have already provided suffucient space and space challenge is very subjective statement hence bidder is requested to comply with specification requirement. |
| 83 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 19 (b) | 8 of 60 | Control and monitoring of air conditioning and ventilation system shall be done from FGD control system.<br>Control and monitoring of air conditioning and ventilation system shall be done from FGD control system. | Bidder wish to clarify that Start, stop control and important parameter monitoring shall be done from FGD control system. | Bidder's understanding is correct. |
| 84 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 19 (c) | 8 of 60 | Control and monitoring of air conditioning and ventilation system shall be done from FGD control system. | Bidder wish to clarify that Start, stop control and important parameter monitoring shall be done from FGD control system. | Bidder's understanding is correct. |
| 85 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 23 | 9 of 60 | Interplant cabling ……Cables crossing Railway line (if applicable) shall be laid underground through nearest culvert. Necessary statutory clearance if required shall be taken by Bidder | Bidder would like to use same philosophy for the pipes crossing railway line. Hence bidder requests employer to allow use of existing nearest culvert for slurry/water pipe lines also. | Bidder's request may be consider only in case there is sufficient space available and no safety issue. At this point of time it can not be confirmed. In view of this bidder to consider scope as per the specification requirement. |
| 86 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 42 | 16 of 60 | For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015 for Earthquake loads. | As per IS:1893 (Part 4):2015, Bidder will carry out this analysis for verification of mechanism, only for category-1 structure (If any). | For Industrial structures, method of structural anlaysis (for seismic design) may be retained linear, for structure cateogary 2 to 4. |
| 87 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 46 | 16 of 60 | Single-flue chimney(s) shall be provided, except for Tanda TPP (2X660MW) and Meja TPP (2X660MW) where twin-flue Chimney shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point for single flue chimney shall be minimum 150 meters above the plant grade level and for twin flue chimney flue gas emission point shall be minimum 220m above the plant grade level.<br>The centre to centre distance between the proposed chimney(s) and the existing chimney(s) in any direction shall not be less than 150 metres. For Barh-I (3X660MW) already existing 275m high chimneys shall be utilized with modifications as specified elsewhere in mechanical specification and hence, new chimney is not to be provided under FGD package. General Arrangement Drawing of already existing Chimneys at Barh-I are provided in Sub Section-II -A10, Part A, Section-VI for reference. | For Meja and Tanda ,bidder had proposed twin flue chimney in the past considering space constraint. In the latest amendment additional space have been provided by employer and it is now possible to go for single flue chimney's for each unit. Hence Bidder requests employer to allow flexibility of both options of single/twin flue chimney depending on layout. | Both options of single / twin flue chimney is allowed for Meja & Tanda. |
| 88 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 112 | 43 of 60 | All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized/pneumatic valves shall be …… shall be taken from the process water supply. The process water lines shall be provided with pneumatic/motorized valves as per the proven practice of the Bidder. | Bidder wish to clarify that all water line ( like process water, equipment seal water, blow down water, clarified water, cake & belt wash water etc) shall be provided with pneumatic/motorised valves as per the proven practice of the Bidder. | Specification requirement is clear in this regard. Bidder is requested to follow the technical specification. |
| | | | | | | |
| | | | | 1. Kudgi (3x800 MW)<br>**9573-999-POC-F-001 Rev.8 (Civil Annex 6)** | Kudgi 3X800 MW: Considering the challenge of construction in unit#1 due to space constraint, bidder requests employer to allow Comissioining/C.O.F of unit#3 first followed by Unit#2 and Unit#1 in this sequence. | Same shall be decided during detail Engineering. |
| | | | | 2. Lara (2x800 MW)<br>9548-999-POM-F-001 Rev.9 (Civil Annex 7) | | |
| | | | | 3. Gadarwara (2x800 MW)<br>9572-999-POC-F-001 **Rev.7 (Civil Annex 8)** | | |

# Lot1A Flue Gas Desulpurization Package
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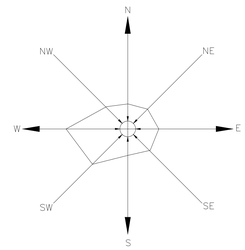
|---|---|---|---|---|---|---|
| 89 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No.-63 | 25 of 60 | 4. Darlipali (2x800 MW)<br>9549-999-POC-F-001 Rev.11 (Civil Annex 9) | | |
| | | | | 5. Mouda (2x660 MW)<br>9561/9575-999-POC-F-001 Rev.12 | | |
| | | | | | | |
| | | | | 6. Solapur (2x660 MW) | | |
| | | | | 9571-999-POC-F-001 Rev.6 (Civil Annex 11) | | |
| | | | | **7. Tanda (2x660 MW)** | | |
| | | | | 9562-999-POC-F-002 Rev.10 (Civil Annex 12) | | |
| | | | | **8. Nabinagar JV (3x660 MW)**<br>**0370-999-PO-F-001 Rev.11 (Civil Annex 13)** | Nabinagar 3X660MW:'Bidder requests employer to allow Space besides ESP control room of unit#1 for FGD use. | Bidder to note that space available between C.L of pipe/cable trestle column and ESP/VFD control room including transformer handling/withdrawal space shall be max. 15m at the ground level, Bidder may plan their FGD facilities without disturbing existing facilities/structure/foundation both above and below ground in the referred area. |
| | | | | 9. Meja (2x660 MW) | | |
| | | | | 0360/0361-999-POC-F-001 Rev.8 (Civil Annex 14) | | |
| | | | | 10. Barh (3x660 MW) | | |
| | | | | 9558/9560-999-POC-F-001 Rev.9 (Civil Annex 15) | | |
| | | | | 11. Nabinagar (4x250MW) | | |
| | | | | 0270-999-POC-F-001 Rev. 9 (Civil Annex 16) | | |
| 90 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 136 (Mech Annexure-IV) | 54 OF 60 | Revised AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT is enclosed at Mech Annexure-IV | Bidder would like to clarify that Different units have different duct lengths and as such the guaranteed power consumption shall be different. Bidder requests employer to allow declaration of unitwise power consumption guarantees in attachment 5P (Rev-01).<br>Further Bidder requests employer to allow declaration of unitwise guaranteed limestone consumption in the same Attachment 5P | As per the revised Auxiliary power consumption (Mechanical Annexure IV to Amendment 05/T) Bidder to quote average Auxiliary power consumption for e.g. In case of one project is having two unit then Guaranteed APC shall be average of APC of U#1 and APC of U#2. With this provision Bidder's concern is already taken care.<br>Bidder to guarantee Limestone consumption same for all unit as it is not dependent on layout. |
| 91 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 108 | 41 OF 60 | All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS: 803, latest edition. Additional Corrosion allowance of 1.5 mm on the minimum tank shell thickness as calculated by IS: 803, latest edition shall be provided by the Contractor. Tanks shall be made from IS: 2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replaceable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake glass lining of minimum 3 mm thickness or Epoxy lining minimum three coats of 150 micron thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. | Bidder understands that the total thickness of epoxy lining/paint shall be 3X50 micron = 150 micron (Total).<br>Bidder requests employer to confirm the same. | Bidder's understanding is correct. |
| 92 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 142 C | 59 OF 60 | 2x100% electric driven, single stage, integrally geared, single or dual vane centrifugal type / positive displacement (Helical lobe) type with VFD drive, oxidation blowers complete with integral gearbox, lube oil system, instrumentation and accessories. The blower will be used for supplying a variable volume of air to the absorber reaction tank. | Bidder understands that VFD shall not be applicable for centrifugal type oxidation blower with vane control. Bidder requests employer to confirm the same. | Bidder's understanding is correct. VFD is not mandatory for centrifugal type oxidation blower |
| 93 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 134 | 53 OF 60 | Mandatory Spares List (For each Project) - Cl. No. 1.01.00 to 1.17.00 revised attached as Mech Annexure III<br>Sl No 1.02.00 Gates in Flue Gas System<br>1. Seals<br>2.<br>3 Expansion Joints<br>4.Seals for guillotine gate(Both port side and bonnet side) (In case Gates are provided) | Bidder understand that there is typo error for mandatory spares of Gates, as seals is repeating in sl no 1 and 4 also expansion joints is not applicable in gates. Bidder requests employer to confirm the same. | Regarding seals bidders understanding is correct. For Expansion joint, this shall be applicable for expansion joints of ducting. |
| 94 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 144 | 59 OF 60 | The absorber vessel shall be made of minimum 7 mm thick carbon steel.<br>The absorber oxidation tank, absorber tower & absorber outlet duct up to absorber outlet flange shall be provided with 2 mm (minimum) thickness lining / cladding / Alloy C276 / Alloy 59 or better material. | Bidder understand that lining here implies wall papering as allowed in original Tender. Bidder requests employer to confirm the same. | It is clarified that only cladded plate of Alloy C276/ Alloy 59 or better material with Carbon steel base is allowed. Cladded plate can be manufactured by either rolling or explosion bonding process. |
| 95 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 38 | 14 OF 60 | "SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT" of Lara STPP Project given in "Civil Annexure-2" to this amendment shall replace the "SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT" Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T)), Sl.No. 13, Page-8 of 102 | Bidder requests employer to provide the missing bore log data for all the projects. Bidder has updated missing borelog data coordinates for each project. | All Bore log data available with NTPC for that vicinity has already been provided. |

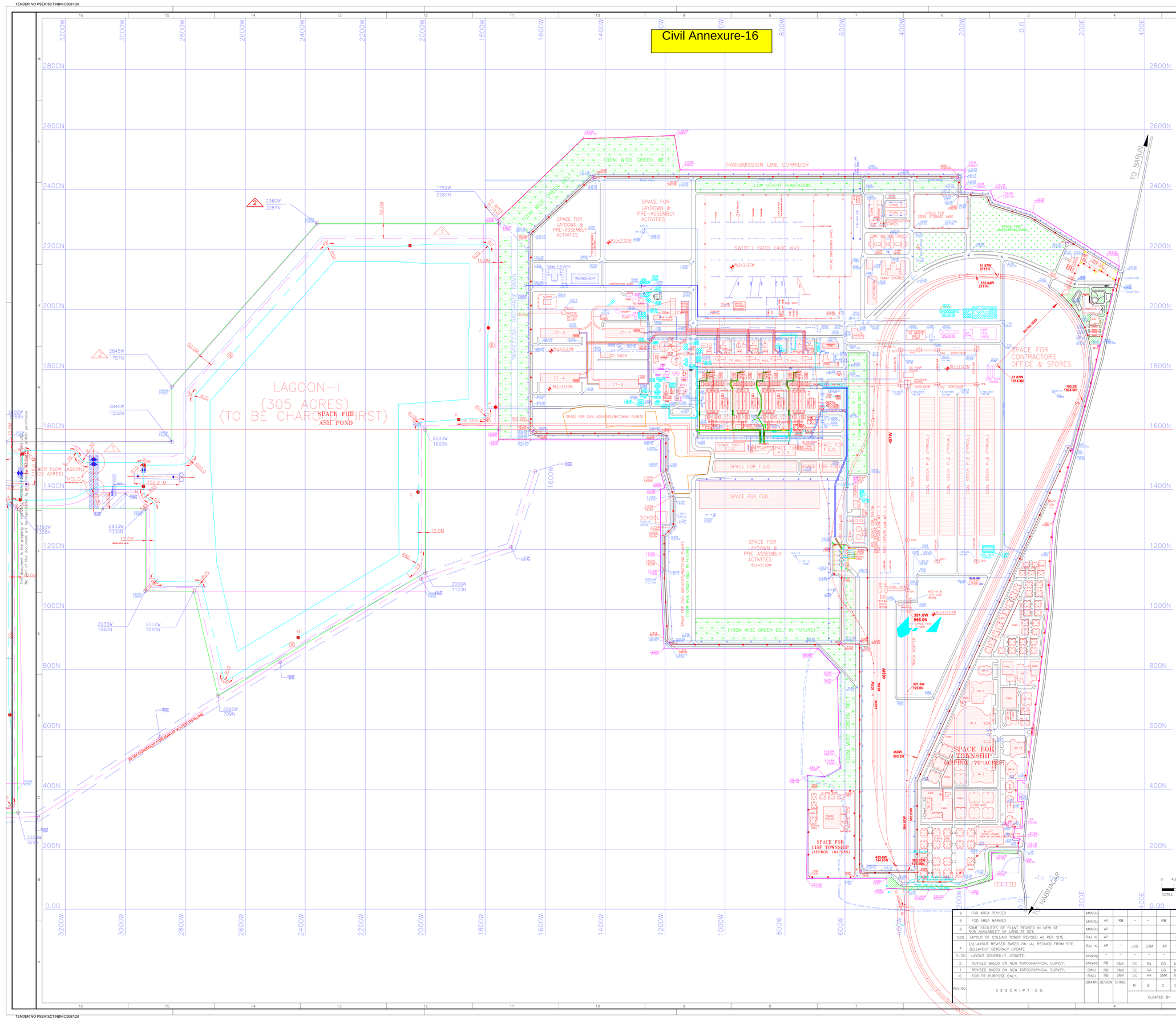
# Lot1A Flue Gas Desulpurization Package
## Clarification No.04 (Technical)

| S.No. | Section/Part | Clause No. | Page No | Clause | Clarification | NTPC's Reply |
|---|---|---|---|---|---|---|
| 96 | AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T) | Sl. No. 140 | 56 OF 60 | Barh-I (3X660MW) clauses and drgs revised considering that FGD outlet will<br>led to existing chimney and accordingly absorber discharge will be connected to ID fan discharge duct with additional damper(s). Bypass duct from bypass<br>damper to chimney and existing chimney shall be lined. Further, Condensate<br>draining system and condensate study shall also be in the bidder's scope.<br>Sketch and details are enclosed at Mechanical Annexure-VI<br><br>**Mech Annex VI**<br>1.05.00 :Wet Stack condensate collection system & condensate study<br>Existing stack shall----------<br>----------with a draining system as per EPRI guidelines | Bidder would like to inform that in case of Barh, existing chimney can not be converted into wet stack inline with EPRI guidelines because in Barh existing stack flue gas velocity will be highre than the EPRI recommended velocity hence it will be a devaition from EPRI guideline.<br><br>Bidder also requests employer to provide the additional details of existing chimney i.e flue can drawing from breeching joint to top of stack, number of expansion joints with detail , number of platform inside existing stack etc., present conditions of flue can.<br>Further Bidder is discussing with sub-vendors for stack conversion and will get back to employer if any additional information is required. | Bidder understanding on velocity in chimney is correct. Consider pressure drop of 40 mm through chimney or actual whichever is higher. Velocity inside the duct and chimney can be calculated based on the FGD flow at the absorber outlet. Additiona data, if required, shall be provided during detail Engineering. |
| 97 | | | General | | Bidder would like to clarify that due to the the Technical Ammendment No 5 the bid documents (Layout , Process Flow Diagram , Technical Datasheet , Single Line Diagram, Control Overview Diagram) shall have a major impact and calls for revision, Bidder requests employer to advice how these changes can be incorporated during the Bidding phase. Accordingly bidder shall submit the revised Documents / Drawings. | Layout & other Amendments have been issued based on discussion with Bidders. Bidders are requested to comply with the specification requirements. Bidder shall be required to submit the revised documents/Drawings during detail engineering. |
| 98 | TECHNICAL SPECIFICATION | | 9 of 26 | The wet stack shall be designed as per the guidelines of EPRI Revised Wet Stack Design Guide. | As per amendment 5(T), Existing chimney with fixed flue ID of 7650 mm is to be utilised with suitable modification. | Bidder understanding on velocity in chimney is correct. For draft loss, consider pressure drop of 40 mm through chimney or actual whichever is higher. Velocity inside the duct and chimney can be calculated based on the FGD flow at the absorber outlet. |
| | SECTION-VI, PART-A, SUB-SECTION-V | | | & | | |
| | CL. NO. 5.0.0 | | | Flue Gas velocity (m/s) - < 18 at Design Point | As per technical specification, Flue Gas velocity (m/s) - < 18 at Design Point. | |
| | Amendment 5(T) Sr. no. 46 | | 16 of 60 | For Barh-I (3X660MW) already existing 275m high chimneys shall be utilized with modifications ..... | | |
| | Amendment 5(T), Mechanical Annex.-VI, Dwg. no. 9558-102-PVM-F-020 | | 18 of 19 | Flue ID – 7650 mm | Considering above and Technical specification/amendment requirement of borosilicate lining, the flue gas velocity cannot be limited as specified. | |

# Civil Annexure-16




WIND ROSE
(DEHRI)




## LEGEND:

1. DISPUTED LAND . . . . . 
2. FACILITES TO BE SHIFTED . . . .
3. SHIFTED FACILITES . . . .

## NOTES:

1. ALL DIMENSIONS AND LEVELS ARE IN METRES.
2. FOR DETAILS IN MAIN PLANT BLOCK REFER MAIN PLANT LAYOUT DRG. NO. 0270-999-POM-F-001.
3. THE FORMATION GROUND LEVELS AS SHOWN ARE INDICATIVE ONLY.
4. LEVEL TRANSFERED BY DOUBLE TERTIARY LEVELLING FROM GTS BENCH MARK ON NORTH END OF EAST PARAPET OF THE HEAD SLUICE OF CANAL ON THE RIGHT OF THE SON RIVER NEAR KM STONE 29 ON NABINAGAR-BARUN ROAD.

## LEGEND:

1. ROADS (DOUBLE LINE) . . . . . 
   ROADS (SINGLE LINE) . . . . . 
2. BOUNDARY WALL . . . . . 
3. FENCING . . . . . 
4. RAILWAY LINE . . . . . 
5. FACILITIES/ BUILDINGS . . . . . 
6. WATCH TOWER . . . . . 
7. FORMATION LEVEL . . . . . RL(+)127M
8. LAND ACQUISITION LINE . . . . . 

SCALE 0 40 80 120 160 200M

| REV.NO. | DESCRIPTION | DRAWN | DESIGN | CHKD. | CLEARED BY M | E | C | C&I | ES | APPD | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | FGD AREA REVISED | MANOJ | | | | | | | | | 22.02.19 |
| 8 | FGD AREA MARKED | MANOJ | AA | RB | – | – | RB | – | – | | 25.10.17 |
| 6 | SOME FACILITIES OF PLANT REVISED IN VIEW OF NON AVAILABILITY OF LAND AT SITE | MANOJ | AP | | | | | | | | 03.02.14 |
| 5DD | LAYOUT OF COLLING TOWER REVISED AS PER SITE | RAJ. K. | AP | – | | | | — | | – | 25.04.13 |
| 4 | (a) LAYOUT REVISED BASED ON LAL RECIVED FROM SITE (b) LAYOUT GENERALY UPDATE | RAJ. K. | AP | – | JGG | SSM | AP | — | – | SMK | 09.02.11 |
| 3-DD | LAYOUT GENERALLY UPDATED. | prayag | – | – | – | – | – | – | | – | 09.04.09 |
| 2 | REVISED BASED ON NEW TOPOGRAPHICAL SURVEY. | prayag | RB | SMK | SC | RA | DG | MPS | RK | SKC | 05.05.08 |
| 1 | REVISED BASED ON NEW TOPOGRAPHICAL SURVEY. | BINU | RB | SMK | SC | RA | DG | MPS | RK | SKC | 15.01.04 |
| 0 | FOR FR PURPOSE ONLY. | BINU | RB | SMK | SC | RA | SMK | MPS | RK | SKC | 20.06.03 |

OWNER
BHARTIYA RAIL BIJLEE COMPANY LTD.

CONSULTANT
NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT
NABINAGAR THERMAL POWER PROJECT
(4X250MW)

TITLE
GENERAL LAYOUT PLAN

| SIZE | SCALE | DRG. NO. | REV. NO. |
|---|---|---|---|
| A0 | 1 : 4000 | 0270-999-POC-F-001 | 9 |

FILE: Nabinagar-0270-999-POC-F-001

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# Flue Gas Desuplhurisation (FGD) System Package for Lot-1A Projects

**Common Bidding Document No. : CS-0011-109(1A)-2**

## Errata No. 01 to Section-VI

## Errata No. 01 to Technical Specifications, Section-VI

| Sl. No. | Clause Ref. | Amendment | |
|---|---|---|---|
| | | **Instead Of** | **Read As** |
| 1. | Project information file for Nabinagar STPP (3X660 MW), NPGCPL (Sec VI-ProjInfo-Nabinagar-A8-1 ) | Sec VI-ProjInfo-Nabinagar-A8-1 (pdf file) is unreadable | Replace existing pdf file Sec-VI-ProjInfo-Nabinagar-A8-1 with Sec VI-ProjInfo-Nabinagar-A8-1 (Rev-1) |

# SUB-SECTION-II-A8

# PROJECT INFORMATION- NABINAGAR-I 3X660 MW

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|
| **1.00.00** | **BACKGROUND**<br><br>A Joint Venture Agreement was signed between NTPC and BSEB/ Govt. of Bihar on 14.02.2008 for Establishment and Operation & Maintenance of 3x660 MW capacity coal based thermal power project near Nabinagar Distt Aurangabad Bihar and thereafter a Joint Venture company namely, Nabinagar Power Generating Company Private Limited (NPGCPL) was incorporated with equity structure of 50% each by NTPC and BSEB on 09.09.2008.The project shall be a mega project and shall be implemented during XII Plan period. |
| **1.01.00** | **Location**<br><br>The plant is located in Aurangabad district of Bihar at a distance of about 15 kms. from Barun in Aurangabad district of Bihar and is approachable from NH-2 through a 20 kms (approx.) long single lane metalled road. The Aurangabad city is about 55 kms. from project site.<br><br>Nearest railway station is Ankorha on Sone – Garwa Road Section of Eastern Central Railway at about 1.0 Kms. from the project site.<br><br>**Airport**<br><br>The nearest airport at Gaya is at a distance of about 120 Kms from project site. The distances of site from Patna Airport and Varansi Airport are about 250 Kms & 220 Kms respectively.<br><br>Vicinity plan of the proposed project is placed at **Annexure -I** |
| **1.02.01** | **Land**<br><br>About 2500 acres of land required for the project (main plant, township, ash disposal areas and corridors etc.) has been identified. Govt. of Bihar have accorded in-principle clearance for availability of land vide letter dated 15.06.2007 and 27.02.2009. |
| **1.02.02** | **Coal**<br><br>Coal requirement for the project is estimated about 11.25 million tonnes/annum corresponding to 90% PLF. Likely coal source for the project is North Karanpura coalfields of CCL.<br><br>Application for Long Term Coal Linkage has been submitted to Ministry of Coal, Govt. of India on 21.06.2007 & 06.10.2008. |
| **1.02.03** | **Water**<br><br>The project site is located near the river Sone and the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage on river Son, which is about 3 kms from the proposed site.<br><br>Make up water requirement for this project would be about 7550 Cu.M/hr with ash water recirculation system and about 8480 Cu.M/hr with once through ash water system. |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|
| | Govt. of Bihar has accorded water commitment for availability of 125 cusecs of water vide letter dated 06.06.2007. |
| **1.03.00** | **Railway Siding**<br><br>Employer intends to construct the Railway siding to project site from the nearest existing railway line. However, the same may not be available to the bidder for his use to transport equipment & material.<br><br>Bidder may visit the site and acquaint themselves with the facilities available. |
| 1.04.00 | (i) **Coal Quality Parameters / Fuel Oil Characteristics & Plant Water details:**<br><br>The coal quality parameters and Fuel oil Characteristics are indicated in Table-1 & Table-2A & 2B resp. below.<br><br>**Water data**<br><br>(ii) Process water:<br>Source:<br>Terminal point:<br>Process water quality is based on COC given in Table-3.<br><br>(iii) Clarified water:<br>Terminal point:<br>Clarified water quality is indicated in Table-3.<br><br>(iv) DM water for Equipment cooling water system.<br>Terminal point:<br>DM water quality is indicated in Table-4. |
| 1.05.00 | **Steam Generator and ESP data:** refer Table-5. |
| 1.06.00 | Drawings are enclosed as per **Table-6** for initial overview to the Bidder. |
| 2.00.00 | NOT USED |
| 3.00.00 | **Capacity : 3 x 660 MW** |
| 4.00.00 | **Metrological Data**<br><br>Important meteorological data from nearest observatory at Dehri is placed at Annexure -II. |
| **5.00.00** | **CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**<br><br>All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).

**Damping in Structures**

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a) Steel structures : 2%

b) Reinforced Concrete structures : 5%

c) Reinforced Concrete Stacks : 3%

d) Steel stacks : 2%

**Method of Analysis**

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|
| | performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).<br><br>In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).<br><br>The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.<br><br>For buildings, if the design base shear ($V_B$) obtained from modal combination is less than the base shear ( $\bar{V}_B$) computed using the approximate fundamental period ($T_a$) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B$/ $V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than $V_B$.<br><br>For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I.<br><br>**Design/Detailing for Ductility for Structures**<br><br>The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility. |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**APPENDIX – I**

**SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT**

The various site specific seismic parameters for the project site shall be as follows:

1) Peak ground horizontal acceleration : 0.16g

2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra

a) for ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.04

b) for braced steel frames designed and detailed as per IS:800 : 0.03

c) for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024

d) For RCC chimney : 0.08

e) For Liquid retaining tanks : 0.048

d) for Steel chimney and Absorber tower : 0.06

d) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.04

3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.08

Note: g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

## APPENDIX – I

### HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
### In units of 'g' for BRBCL project

| Time Period (Sec) | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| | 2% | 3% | 5% |
| 0.000 | 1.000 | 1.000 | 1.000 |
| 0.030 | 1.000 | 1.000 | 1.000 |
| 0.050 | 1.750 | 1.607 | 1.443 |
| 0.100 | 3.737 | 3.060 | 2.374 |
| 0.104 | 3.904 | 3.174 | 2.443 |
| 0.123 | 3.904 | 3.401 | 2.753 |
| 0.150 | 3.904 | 3.401 | 2.753 |
| 0.200 | 3.904 | 3.401 | 2.753 |
| 0.250 | 3.904 | 3.401 | 2.753 |
| 0.300 | 3.904 | 3.401 | 2.753 |
| 0.350 | 3.904 | 3.401 | 2.753 |
| 0.400 | 3.904 | 3.401 | 2.753 |
| 0.450 | 3.904 | 3.401 | 2.753 |
| 0.500 | 3.904 | 3.401 | 2.753 |
| 0.516 | 3.904 | 3.401 | 2.753 |
| 0.550 | 3.662 | 3.401 | 2.753 |
| 0.600 | 3.357 | 3.142 | 2.753 |
| 0.607 | 3.320 | 3.105 | 2.753 |
| 0.670 | 3.006 | 2.813 | 2.493 |
| 0.700 | 2.877 | 2.693 | 2.386 |
| 0.750 | 2.685 | 2.513 | 2.227 |
| 0.800 | 2.518 | 2.356 | 2.088 |
| 0.850 | 2.369 | 2.218 | 1.965 |
| 0.900 | 2.238 | 2.094 | 1.856 |
| 0.950 | 2.120 | 1.984 | 1.758 |
| 1.000 | 2.014 | 1.885 | 1.670 |
| 1.050 | 1.918 | 1.795 | 1.590 |
| 1.100 | 1.831 | 1.714 | 1.518 |
| 1.150 | 1.751 | 1.639 | 1.452 |
| 1.200 | 1.678 | 1.571 | 1.392 |
| 1.250 | 1.611 | 1.508 | 1.336 |
| 1.300 | 1.549 | 1.450 | 1.285 |
| 1.350 | 1.492 | 1.396 | 1.237 |
| 1.400 | 1.439 | 1.346 | 1.193 |
| 1.450 | 1.389 | 1.300 | 1.152 |
| 1.500 | 1.343 | 1.257 | 1.113 |
| 1.550 | 1.299 | 1.216 | 1.077 |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

## APPENDIX – I

### HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
### In units of 'g' for BRBCL project

| Time Period (Sec) | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| | 2% | 3% | 5% |
| 1.600 | 1.259 | 1.178 | 1.044 |
| 1.650 | 1.221 | 1.142 | 1.012 |
| 1.700 | 1.185 | 1.109 | 0.982 |
| 1.750 | 1.151 | 1.077 | 0.954 |
| 1.800 | 1.119 | 1.047 | 0.928 |
| 1.850 | 1.089 | 1.019 | 0.903 |
| 1.900 | 1.060 | 0.992 | 0.879 |
| 1.950 | 1.033 | 0.967 | 0.856 |
| 2.000 | 1.007 | 0.943 | 0.835 |
| 2.050 | 0.982 | 0.920 | 0.815 |
| 2.100 | 0.959 | 0.898 | 0.795 |
| 2.150 | 0.937 | 0.877 | 0.777 |
| 2.200 | 0.915 | 0.857 | 0.759 |
| 2.250 | 0.895 | 0.838 | 0.742 |
| 2.300 | 0.876 | 0.820 | 0.726 |
| 2.350 | 0.857 | 0.802 | 0.711 |
| 2.400 | 0.839 | 0.785 | 0.696 |
| 2.450 | 0.822 | 0.769 | 0.682 |
| 2.500 | 0.806 | 0.754 | 0.668 |
| 2.550 | 0.790 | 0.739 | 0.655 |
| 2.600 | 0.775 | 0.725 | 0.642 |
| 2.650 | 0.760 | 0.711 | 0.630 |
| 2.700 | 0.746 | 0.698 | 0.619 |
| 2.750 | 0.732 | 0.685 | 0.607 |
| 2.800 | 0.719 | 0.673 | 0.596 |
| 2.850 | 0.707 | 0.661 | 0.586 |
| 2.900 | 0.694 | 0.650 | 0.576 |
| 2.950 | 0.683 | 0.639 | 0.566 |
| 3.000 | 0.671 | 0.628 | 0.557 |
| 3.050 | 0.660 | 0.618 | 0.548 |
| 3.100 | 0.650 | 0.608 | 0.539 |
| 3.150 | 0.639 | 0.598 | 0.530 |
| 3.200 | 0.629 | 0.589 | 0.522 |
| 3.250 | 0.620 | 0.580 | 0.514 |
| 3.300 | 0.610 | 0.571 | 0.506 |
| 3.350 | 0.601 | 0.563 | 0.499 |
| 3.400 | 0.592 | 0.554 | 0.491 |
| 3.450 | 0.584 | 0.546 | 0.484 |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**APPENDIX – I**

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS**
**In units of 'g' for BRBCL project**

| Time Period (Sec) | Damping Factor (as a percentage of critical damping) | | |
|---|---|---|---|
| | 2% | 3% | 5% |
| 3.500 | 0.575 | 0.539 | 0.477 |
| 3.550 | 0.567 | 0.531 | 0.470 |
| 3.600 | 0.559 | 0.524 | 0.464 |
| 3.650 | 0.552 | 0.516 | 0.458 |
| 3.700 | 0.544 | 0.509 | 0.451 |
| 3.750 | 0.537 | 0.503 | 0.445 |
| 3.800 | 0.530 | 0.496 | 0.439 |
| 3.825 | 0.527 | 0.493 | 0.437 |
| 3.850 | 0.523 | 0.490 | 0.434 |
| 3.900 | 0.516 | 0.483 | 0.428 |
| 3.950 | 0.510 | 0.477 | 0.423 |
| 4.000 | 0.504 | 0.471 | 0.418 |

**6.00.00** **CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**

All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than "5" and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement

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| | factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.<br><br>**Damping in Structures**<br><br>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:<br><br>a) Welded steel structures : 1.0%<br><br>b) Bolted steel structures : 2.0%<br><br>c) Reinforced concrete structures : 1.6%<br><br>d) Steel stacks : As per IS:6533 & CICIND Model Code whichever is more critical.<br><br>**ANNEXURE-B**<br><br>**SITE SPECIFIC DESIGN PARAMETERS**<br><br>The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:<br><br>a) The basic wind speed "$V_b$" at ten<br><br>b) The risk coefficient "$K_1$" : 1.07<br><br>c) Category of terrain : Category-2 |
| **7.00.0** | **FOUNDATION SYSTEM AND GEOTECHNICAL DATA** |
| 7.00.01 | Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV. |
| 7.00.02 | The available soil data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed soil investigation for facilities under this package and shall be as per the scheme approved by owner**.** The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation. |
| 7.00.03 | The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be payable. |

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| 7.00.04 | Tank Foundations<br>a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any.<br>b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III.<br>c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%.<br>d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications. |
| 7.02.00 | **Foundation System**<br>The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner. |
| **7.02.01** | **General Requirements**<br>a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc.<br>b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil.<br>c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil.<br>d) No foundation shall rest on the black cotton soil.<br>e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost.<br>f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations. |

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| | g) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.<br><br>h) The water table for design purpose shall be considered at Finished Ground Level.<br><br>i) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building.<br><br>j) Foundation for equipments on ground floor<br><br>For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m2. Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications.<br><br>For equipment of static weight more than 1.5 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 1. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab. |
| **7.02.02** | **Open Foundations**<br>In case open foundations are adopted, following shall be adhered to.<br><br>a) The minimum width of foundation shall be 1.0 m.<br><br>b) Minimum depth of foundation shall be 1.0m below Ground Level.<br><br>c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum.<br><br>d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level. |
| 7.02.03 | Pile Foundations –<br>In case piles are adopted, following shall be adhered to : |

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| | i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs/conventional tripod rig. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer.<br><br>If required, temporary or permanent MS liner may be provided for piling.<br><br>ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & as enclosed in relevant annexure:<br><br>iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m.<br><br>iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval.<br><br>v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval.<br><br>vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under.<br><br>Vertical<br><br>Lateral Minimum of 2 Nos. in each mode.<br><br>Uplift<br><br>vii) The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part).<br><br>viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter.<br><br>ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under :<br><br>i) Vertical : 0.5% of the total number of piles provided.<br><br>ii) Lateral : 0.5% of the total number of piles provided. |

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| | x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer.<br><br>xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required.<br><br>xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm.<br><br>xiii) The test load on initial test piles shall be applied by means of reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge with concrete blocks.<br><br>xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM.<br><br>xv) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.<br><br>The procedure to carry out the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components |

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| | of the pile.<br>xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions.<br>xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles.<br>xviii) Reinforcement for job piles shall be designed as following:<br>• Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered.<br>• Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package. |
| **7.03.00** | **Special Requirements** |
| 7.03.01 | Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried out by contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly. |
| **7.04.00** | **Excavation, Filling and Dewatering** |
| 7.04.01 | For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth. |
| 7.04.02 | Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum. |
| 7.04.03 | Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils<br><br>Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices. |

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| 7.04.04 | Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels. |
| 7.04.05 | CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level. |
| 7.04.06 | The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides.<br><br>Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches. |
| **7.05.00** | **EXCAVATION IN ROCK**<br><br>Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out. |
| 7.05.01 | Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type). |
| 7.05.02 | a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting operation. All blasting shall be done as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert.<br><br>b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed.<br><br>c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials.<br><br>d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations. |

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| **7.06.00** | **Sheeting & Shoring**<br><br>The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer. |
| **7.07.00** | **Geotechnical Investigation**<br><br>The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work. |
| 7.07.01.00 | **Scheme of geotechnical Investigation** |
| 7.07.02.01 | Field test shall include but not be limited to the following:<br><br>Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc. |
| 7.07.02.02 | The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit. |
| 7.07.02.03 | The minimum tests are indicated in Clause No. 7.08.00. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50. |
| 7.07.02.04 | Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers.<br><br>**Laboratory Tests on Soil Samples**<br><br>Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell |

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| | Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement/ steel.<br><br>**Laboratory Tests on Rock Samples**<br><br>Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples. |
| 7.07.02.05 | Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards.<br><br>On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc.<br><br>Recommendations on foundation system and the net allowable bearing pressures and pile capacity shall be based on the conservative values of geotechnical investigation data. |
| 7.07.03.00 | Geotechnical investigation work shall be got executed by the Contractor through the following agencies.<br>1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata<br>2. Cengrs Geotechnica Pvt. Ltd, New Delhi<br>3. M.K. Soil Testing Laboratory, Ahemdabad<br>4. SECON Pvt Ltd, Bangalore<br>5. Soil Engineering Consultants, New Delhi<br>6. Orbital Infrastructure Consultancy & Research Pvt. Ltd. Cuttack<br>7. KCT Consultancy Services, Ahemdabad<br>8. ARKITECHNO Consultants (India) Pvt. Ltd. Bhubaneswar |
| **7.08.00** | **Geotechnical Investigation Scheme** |
| a) | **Boreholes (Minimum)** |

| S.N | Structure | Spacing/Number of borehole | Depth of borehole | Remarks |
|---|---|---|---|---|
| 1 | FGD | Minimum 14 Nos. | Depth of boreholes shall be 25m to 35m. | Depth of |

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|---|---|---|---|---|
| 2 | Crusher House | Minimum 2 Nos. | Depth of boreholes shall be 25m to 35m. | boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 25% whichever is earlier. |
| 3 | Gypsum and Lime storage area | Minimum 10 Nos. | Depth of boreholes shall be 15m to 25m | |
| 4 | Other Structure/Facility | Minimum 2 Nos. boreholes under each area / facility | 15 to 20 m | |
| 5 | Chimney | Minimum 2 Nos. | 30 to 35m | |

**b) Other Field Tests (Minimum)**

| | | | |
|---|---|---|---|
| 1 | Cyclic Plate Load Test (CPLT) | 3 nos | Test Depth from 2 to 4 m |
| 2 | Trial Pit (TP) | 5 Nos. | Depth - 3 m |
| 3 | In Situ Permeability Test In Boreholes | In minimum 3 Nos. of boreholes | Tests shall be conducted at depths of 1.0m, 3.0m, 5.0m, 8.0m and 12.0m. |
| 4 | ERT | Minimum 10 Nos. | |

- Depth and location of Boreholes and other field tests (PLT, ERT, field permeability tests etc.) shall be approved by Owner before execution of geotechnical investigation work.
- Investigation in any other building / structure / facilities / trestles which are not mentioned above shall also be carried out, if required, by the bidder for the facilities under his scope.

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**Annexure-III (New Nabinagar-I)**

## SOIL DATA AND FOUNDATION SYSTEM

Employer has carried out geotechnical investigation in the areas near to this package. Logs of representative boreholes to be used for bidder's information in the vicinity of proposed area are enclosed at Annexure-II. The bidder is required to carry out geotechnical investigation as per clause no. 7.07.00 and ascertain the pile capacity and bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. Ground water table is encountered at a depth of about 12.0 to 14.0m below natural ground level (NGL) at the time of investigation. Fluctuation may occur in ground water table due to seasonal variation. The natural ground level is varying as per enclosed contour/spot level drawing.

a) The foundation system to be adopted for different structures shall be as given in Table – 1 below

**2.00.00Table – 1: Net Allowable Bearing Pressure**

| STRUCTURE | TYPE OF FOUNDATION TO BE ADOPTED |
|---|---|
| FGD and related structures | Open/Piles |

b) During design the Allowable Bearing Pressure shall be as furnished in Table-2. Bidder is required to carry out geotechnical investigation in this area. The allowable bearing pressure shall be adopted after approval of geotechnical investigation report by owner. However, the maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to the values as furnished in Table-2.

**3.00.00**

**4.00.00Table – 2: Net Allowable Bearing Pressure**

| Structure | Founding Level in RL | Net Allowable Bearing Pressure $T/m^2$ | | |
|---|---|---|---|---|
| | | Isolated / Strip | | Rafts (width > 6m) for 75mm settlement |
| | | width upto 6 m for 25mm settlement | Width upto 6m for 40mm settlement | |
| FGD and related structures | 1.5 m below NGL | 5.0 | 6.0 | 7.0 |
| | 2.5 m below | 6.0 | 7.0 | 8.0 |

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| | | | | |
|---|---|---|---|---|
| | NGL | | | |
| | 3.5 m below NGL | 9.0 | 10.0 | 12.0 |

The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.

c) Permissible Settlement of Foundations:

For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:

| | |
|---|---|
| Isolated, Strip & Raft (Mill foundations/machine foundation) | 25 mm |
| Isolated & Strip (Other than Mill foundations/machine foundation) | 40 mm |
| Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation) | 75 mm |

In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.

d) The diameter of pile, minimum length and maximum allowable capacity of piles shall be as given below:

| Area/ Location | Pile Diameter (mm) | Minimum Length of Bored Pile Below Cut-off Level (m) | Safe Load Capacity in | | |
|---|---|---|---|---|---|
| | | | Vertical Comp. (MT) | Pullout (MT) | Lateral (MT) |
| FGD and related structures | 600 | 26.0 | 140.0 | 45.0 | 7.0 |
| | 760 | 27.0 | 250 | 75.0 | 12.5 |

- Cut off Level (COL) is assumed at 3.0 m below FGL (RL (+) 121.2m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.

e) The criteria for Pile Termination (founding level) shall be as given below:

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| | |
|---|---|
| Cement Type | Ordinary Portland Cement (OPC)/Portlanld Pozzolana Cement (PPC) |
| Concrete Grade | As specified elsewhere in the specifications |
| Type of Reinforcement | As specified elsewhere in the specifications |
| Cover to Reinforcement | As specified elsewhere in the specifications |

The termination level of the pile shall be decided based on the following criterion

i) Minimum length of the pile below COL (cut off level) shall be as specified above

ii) The minimum pile length for each group of piles shall be determined based on the nearest borelog. A minimum embedment of 4.0m into the very dense sand strata with SPT 'N' value greater than 40 as observed in such borelog shall be ensured, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby borelog data. The boreholes are in the bidder's scope and shall be conducted as per the enclosed scheme.

iii) However, in no case the length of pile shall be less than the minimum length determined as in (i) or (ii) above whichever is longer, for that pile group.

g) Special Requirements:

1) Chemicals in ground water and subsoil, as observed during investigation are:

| Chemical | $SO_3$ | Chlorides | pH |
|---|---|---|---|
| Ground Water | 35 -40 | 15 - 22 ppm | 7.2 - 7.7 |
| Sub-soil | 0.01 - 0.02% | 0.016 -0.02% | 7.0 - 9.0 |

2) In view of the above, the following shall be adopted for all foundations and sub-structures,

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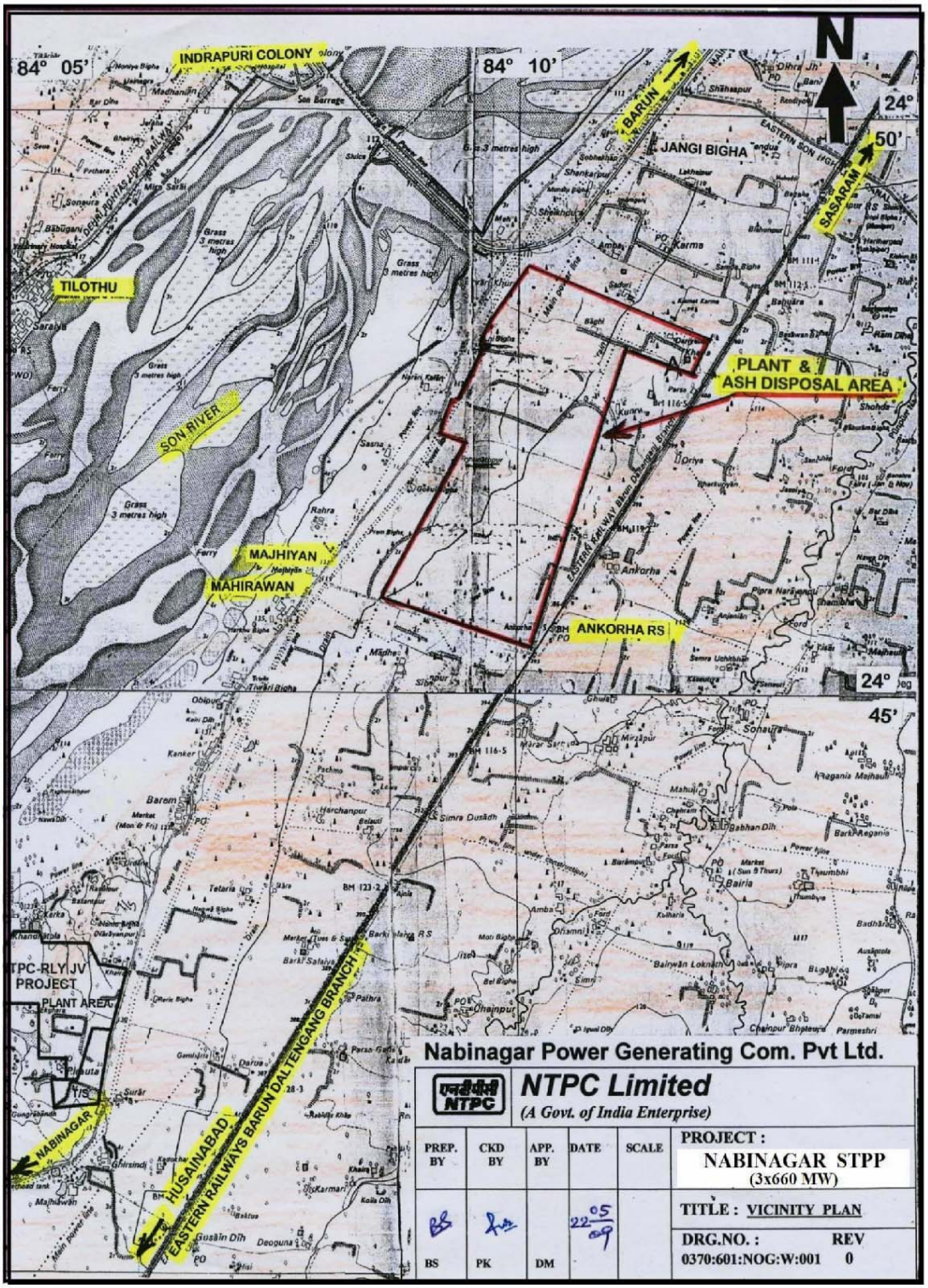
***ANNEXURE – I***

**EXHIBIT - 1**



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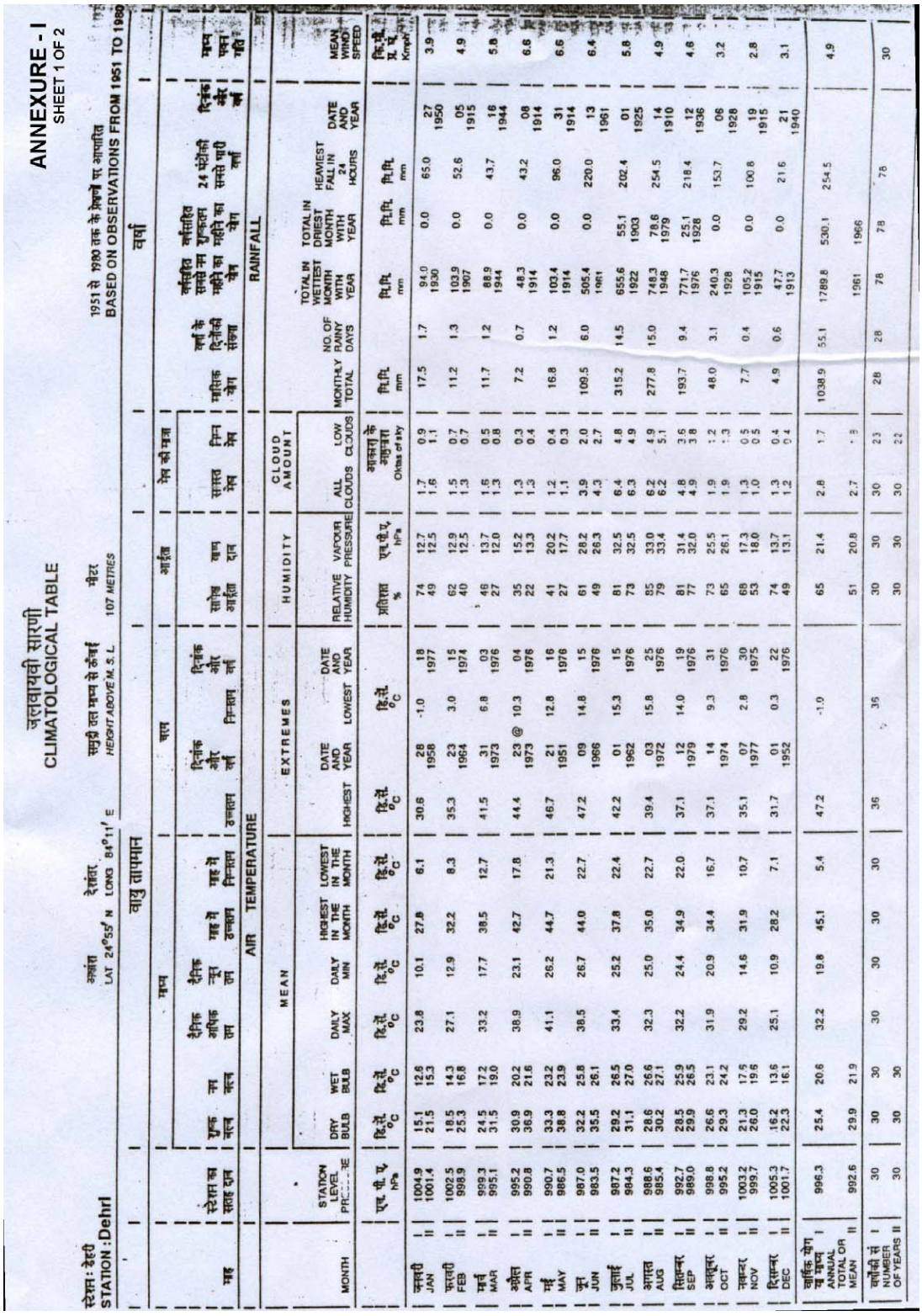
|---|---|

***ANNEXURE –II***



**ANNEXURE - I**
SHEET 1 OF 2

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन: देहरी
STATION : Dehri

अक्षांश LAT 24°55′ N देशांतर LONG 84°11′ E समुद्री तल स्तर से ऊँचाई HEIGHT ABOVE M. S. L. 107 METRES

1951 से 1980 तक के रेकार्ड पर आधारित
BASED ON OBSERVATIONS FROM 1951 TO 1980

| महीना MONTH | | स्टेशन स्तर पर वायु दाब STATION LEVEL PRESSURE hPa | वायु तापमान AIR TEMPERATURE: औसत MEAN: शुष्क बल्ब DRY BULB °C | आर्द्र बल्ब WET BULB °C | दैनिक अधिकतम का औसत DAILY MAX °C | दैनिक न्यूनतम का औसत DAILY MIN °C | महीने में उच्चतम HIGHEST IN THE MONTH °C | महीने में निम्नतम LOWEST IN THE MONTH °C | चरम: उच्चतम HIGHEST °C | दिनांक और वर्ष DATE AND YEAR | चरम: निम्नतम LOWEST °C | दिनांक और वर्ष DATE AND YEAR | आर्द्रता HUMIDITY: सापेक्ष आर्द्रता RELATIVE HUMIDITY % | वाष्प दाब VAPOUR PRESSURE hPa | मेघ की मात्रा CLOUD AMOUNT: समस्त मेघ ALL CLOUDS Oktas of sky | निम्न मेघ LOW CLOUDS | मासिक योग MONTHLY TOTAL mm | वर्षा के दिनों की संख्या NO. OF RAINY DAYS | वर्षा RAINFALL: वर्षीलित समस्त मास का योग TOTAL IN WETTEST MONTH WITH YEAR mm | वर्षीलित न्यूनतम मास का योग TOTAL IN DRIEST MONTH WITH YEAR mm | 24 घंटों की समस्त घड़ी का योग HEAVIEST FALL IN 24 HOURS mm | दिनांक और वर्ष DATE AND YEAR | पवन गति MEAN WIND SPEED Km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| जनवरी JAN | I | 1004.9 | 15.1 | 12.8 | 23.8 | 10.1 | 27.8 | 6.1 | 30.8 | 28 1958 | -1.0 | 18 1977 | 74 | 12.7 | 1.7 | 0.9 | 17.5 | 1.7 | 94.0 1930 | 0.0 | 65.0 | 27 1950 | 3.9 |
| | II | 1001.4 | 21.5 | 15.3 | | | | | | | | | 49 | 12.5 | 1.6 | 1.1 | | | | | | | |
| फरवरी FEB | I | 1002.5 | 18.5 | 14.3 | 27.1 | 12.9 | 32.2 | 8.3 | 35.3 | 23 1964 | 3.0 | 15 1974 | 62 | 12.9 | 1.5 | 0.7 | 11.2 | 1.3 | 103.9 1907 | 0.0 | 52.6 | 05 1915 | 4.9 |
| | II | 998.9 | 25.3 | 16.8 | | | | | | | | | 40 | 12.5 | 1.3 | 0.7 | | | | | | | |
| मार्च MAR | I | 999.3 | 24.5 | 17.2 | 33.2 | 17.7 | 38.5 | 12.7 | 41.5 | 31 1973 | 6.8 | 03 1976 | 46 | 13.7 | 1.6 | 0.5 | 11.7 | 1.2 | 88.9 1944 | 0.0 | 43.7 | 16 1944 | 5.8 |
| | II | 995.1 | 31.5 | 19.0 | | | | | | | | | 27 | 12.0 | 1.3 | 0.8 | | | | | | | |
| अप्रैल APR | I | 995.2 | 30.9 | 20.2 | 38.9 | 23.1 | 42.7 | 17.8 | 44.4 | 23 @ 1973 | 10.3 | 04 1976 | 35 | 15.2 | 1.3 | 0.3 | 7.2 | 0.7 | 48.3 1914 | 0.0 | 43.2 | 08 1914 | 6.8 |
| | II | 990.8 | 36.9 | 21.6 | | | | | | | | | 22 | 13.3 | 1.3 | 0.4 | | | | | | | |
| मई MAY | I | 990.7 | 33.3 | 23.2 | 41.1 | 26.2 | 44.7 | 21.3 | 46.7 | 21 1951 | 12.8 | 16 1976 | 41 | 20.2 | 1.2 | 0.4 | 16.8 | 1.2 | 103.4 1914 | 0.0 | 96.0 | 31 1914 | 6.6 |
| | II | 986.5 | 38.8 | 23.9 | | | | | | | | | 27 | 17.7 | 1.1 | 0.3 | | | | | | | |
| जून JUN | I | 987.0 | 32.2 | 25.8 | 38.5 | 26.7 | 44.0 | 22.7 | 47.2 | 09 1966 | 14.8 | 15 1976 | 61 | 28.2 | 3.9 | 2.0 | 109.5 | 6.0 | 505.4 1961 | 0.0 | 220.0 | 13 1961 | 6.4 |
| | II | 983.5 | 35.5 | 26.1 | | | | | | | | | 49 | 26.3 | 4.3 | 2.7 | | | | | | | |
| जुलाई JUL | I | 987.2 | 29.2 | 26.5 | 33.4 | 25.2 | 37.8 | 22.4 | 42.2 | 01 1962 | 15.3 | 15 1976 | 81 | 32.5 | 6.4 | 4.8 | 315.2 | 14.5 | 655.6 1922 | 55.1 1903 | 202.4 | 01 1925 | 5.8 |
| | II | 984.3 | 31.1 | 27.0 | | | | | | | | | 73 | 32.5 | 6.3 | 4.9 | | | | | | | |
| अगस्त AUG | I | 988.6 | 28.6 | 26.6 | 32.3 | 25.0 | 35.0 | 22.7 | 39.4 | 03 1972 | 15.8 | 25 1976 | 85 | 33.0 | 6.2 | 4.9 | 277.8 | 15.0 | 748.3 1948 | 78.6 1979 | 254.5 | 14 1910 | 4.9 |
| | II | 985.4 | 30.2 | 27.1 | | | | | | | | | 79 | 33.4 | 6.2 | 5.1 | | | | | | | |
| सितम्बर SEP | I | 992.7 | 28.5 | 25.9 | 32.2 | 24.4 | 34.9 | 22.0 | 37.1 | 12 1979 | 14.0 | 19 1976 | 81 | 31.4 | 4.8 | 3.6 | 193.7 | 9.4 | 771.7 1976 | 25.1 1928 | 218.4 | 12 1936 | 4.8 |
| | II | 989.0 | 29.9 | 26.5 | | | | | | | | | 77 | 32.0 | 4.9 | 3.8 | | | | | | | |
| अक्तूबर OCT | I | 998.8 | 26.6 | 23.1 | 31.9 | 20.9 | 34.4 | 16.7 | 37.1 | 14 1974 | 9.3 | 31 1976 | 73 | 25.5 | 1.9 | 1.2 | 48.0 | 3.1 | 240.3 1928 | 0.0 | 153.7 | 06 1928 | 3.2 |
| | II | 995.2 | 29.3 | 24.2 | | | | | | | | | 65 | 26.1 | 1.9 | 1.3 | | | | | | | |
| नवम्बर NOV | I | 1003.2 | 21.3 | 17.5 | 29.2 | 14.6 | 31.9 | 10.7 | 35.1 | 07 1977 | 2.8 | 30 1975 | 68 | 17.3 | 1.3 | 0.5 | 7.7 | 0.4 | 105.2 1915 | 0.0 | 100.8 | 19 1915 | 2.8 |
| | II | 999.7 | 26.0 | 19.6 | | | | | | | | | 53 | 18.0 | 1.0 | 0.5 | | | | | | | |
| दिसम्बर DEC | I | 1005.3 | 16.2 | 13.6 | 25.1 | 10.9 | 28.2 | 7.1 | 31.7 | 01 1952 | 0.3 | 22 1976 | 74 | 13.7 | 1.3 | 0.4 | 4.9 | 0.6 | 47.7 1913 | 0.0 | 21.6 | 21 1940 | 3.1 |
| | II | 1001.7 | 22.3 | 16.1 | | | | | | | | | 49 | 13.1 | 1.2 | 0.4 | | | | | | | |
| वार्षिक योग ANNUAL TOTAL OR MEAN | I | 996.3 | 25.4 | 20.6 | 32.2 | 19.8 | 45.1 | 5.4 | 47.2 | | -1.0 | | 65 | 21.4 | 2.8 | 1.7 | 1038.9 | 55.1 | 1789.8 | 530.1 | 254.5 | | 4.9 |
| | II | 992.6 | 29.9 | 21.9 | | | | | | | | | 51 | 20.8 | 2.7 | 1.3 | | | 1961 | 1966 | | | |
| वर्षों की संख्या NUMBER OF YEARS | I | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 36 | | 36 | | 30 | 30 | 30 | 23 | 28 | 28 | 28 | 28 | 28 | | 30 |
| | II | 30 | 30 | 30 | | | | | | | | | 30 | 30 | 30 | 22 | | | | | | | |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**ANNEXURE - I**
SHEET 2 OF 2

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन देहरी
STATION : Dehri

| MONTH | PPT 0.3mm or more | HAIL | THUN DER | FOG | DUST STORM | SQU ALL | 62 या अधिक | 20-61 | 1-19 | 0 | N | NE | E | SE | S | SW | W | NW | CA LM | 0 | T-2 | 3-5 | 6-7 | 8 | 0 | T-2 | 3-5 | 6-7 | 8 | FOG 8 | UP TO 1 Km | 1-4 Kms | 4-10 Kms | 10-20 Kms | OVER 20 Kms |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| जनवरी JAN | 2.3 | 0.1 | 0.4 | 0.1 | 0.0 | 0.0 | 0 | 0 | 30 | 1 | 2 | 3 | 4 | 11 | 20 | 40 | 9 | 6 | 5 | 23 | 0 | 2 | 2 | 4 | 27 | 0 | 1 | 3 | 0 | 0.1 | 0.4 | 0.5 | 4.0 | 26.0 |
| | | | | | | | 0 | 0 | 30 | 1 | 18 | 11 | 5 | 1 | 2 | 6 | 34 | 17 | 6 | 24 | 0 | 1 | 2 | 4 | 27 | 0 | 1 | 3 | 0 | 0.0 | 0.1 | 0.1 | 0.7 | 30.1 |
| फरवरी FEB | 2.1 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0 | 0 | 28 | 0 | 3 | 3 | 4 | 9 | 17 | 40 | 16 | 7 | 1 | 21 | 0 | 2 | 2 | 3 | 28 | 0 | 0 | 2 | 0 | 0.3 | 0.1 | 0.3 | 1.9 | 25.4 |
| | | | | | | | 0 | 0 | 28 | 0 | 13 | 8 | 5 | 2 | 2 | 4 | 43 | 21 | 2 | 22 | 0 | 1 | 2 | 3 | 25 | 0 | 1 | 2 | 0 | 0.0 | 0.0 | 0.0 | 0.8 | 27.4 |
| मार्च MAR | 1.6 | 0.0 | 0.6 | 0.1 | 0.0 | 0.0 | 0 | 0 | 31 | 0 | 3 | 3 | 4 | 10 | 15 | 41 | 18 | 5 | 1 | 23 | 0 | 3 | 2 | 3 | 28 | 0 | 0 | 2 | 0 | 0.0 | 0.1 | 0.1 | 0.9 | 29.9 |
| | | | | | | | 0 | 0 | 31 | 0 | 8 | 9 | 4 | 2 | 2 | 5 | 50 | 20 | 0 | 24 | 0 | 2 | 2 | 3 | 29 | 0 | 0 | 2 | 0 | 0.0 | 0.2 | 0.2 | 1.5 | 29.1 |
| अप्रैल APR | 1.0 | 0.0 | 0.4 | 0.0 | 0.1 | 0.0 | 0 | 0 | 29 | 1 | 3 | 4 | 9 | 12 | 14 | 31 | 16 | 8 | 3 | 22 | 1 | 3 | 2 | 2 | 29 | 0 | 0 | 1 | 0 | 0.0 | 0.0 | 0.0 | 1.1 | 28.9 |
| | | | | | | | 0 | 0 | 30 | 0 | 6 | 11 | 6 | 3 | 2 | 6 | 43 | 22 | 1 | 24 | 0 | 2 | 2 | 2 | 29 | 0 | 1 | 0 | 0 | 0.0 | 0.0 | 0.1 | 0.3 | 29.6 |
| मई MAY | 1.7 | 0.0 | 0.6 | 0.0 | 0.2 | 0.0 | 0 | 0 | 31 | 0 | 5 | 12 | 14 | 17 | 9 | 21 | 12 | 8 | 2 | 25 | 0 | 2 | 2 | 2 | 30 | 0 | 0 | 1 | 0 | 0.0 | 0.0 | 0.0 | 0.2 | 30.8 |
| | | | | | | | 0 | 0 | 31 | 0 | 9 | 23 | 10 | 2 | 2 | 5 | 28 | 21 | 0 | 25 | 0 | 2 | 2 | 2 | 30 | 0 | 0 | 1 | 0 | 0.0 | 0.0 | 0.0 | 0.2 | 30.8 |
| जून JUN | 7.2 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0 | 0 | 29 | 1 | 8 | 11 | 17 | 19 | 8 | 15 | 13 | 6 | 3 | 11 | 0 | 5 | 5 | 9 | 22 | 0 | 1 | 2 | 5 | 0 | 0.0 | 0.4 | 1.9 | 27.7 |
| | | | | | | | 0 | 0 | 30 | 0 | 10 | 20 | 21 | 8 | 2 | 8 | 19 | 11 | 1 | 12 | 0 | 3 | 5 | 10 | 19 | 0 | 0 | 2 | 7 | 1 | 0.0 | 0.1 | 0.4 | 2.3 | 27.2 |
| जुलाई JUL | 16.9 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 | 0 | 0 | 30 | 1 | 5 | 7 | 16 | 23 | 10 | 19 | 10 | 6 | 4 | 2 | 0 | 6 | 7 | 16 | 10 | 0 | 0 | 2 | 4 | 15 | 0 | 0.0 | 0.3 | 3.9 | 26.8 |
| | | | | | | | 0 | 0 | 30 | 1 | 11 | 13 | 20 | 12 | 6 | 11 | 17 | 6 | 4 | 2 | 1 | 5 | 7 | 16 | 10 | 0 | 0 | 2 | 5 | 14 | 0 | 0.0 | 0.5 | 5.8 | 24.7 |
| अगस्त AUG | 17.6 | 0.0 | 5.1 | 0.0 | 0.0 | 0.0 | 0 | 0 | 30 | 1 | 5 | 7 | 18 | 27 | 10 | 14 | 10 | 7 | 2 | 3 | 0 | 6 | 9 | 14 | 10 | 0 | 0 | 2 | 6 | 13 | 0 | 0.0 | 0.5 | 0.7 | 2.7 | 27.0 |
| | | | | | | | 0 | 0 | 30 | 1 | 10 | 15 | 22 | 10 | 4 | 9 | 19 | 8 | 3 | 3 | 0 | 5 | 8 | 15 | 10 | 0 | 0 | 2 | 4 | 13 | 0 | 0.0 | 0.7 | 1.0 | 3.6 | 25.7 |
| सितम्बर SEP | 11.5 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 0 | 0 | 29 | 1 | 6 | 7 | 16 | 24 | 11 | 11 | 12 | 9 | 4 | 7 | 1 | 5 | 7 | 10 | 15 | 0 | 2 | 4 | 9 | 10 | 0 | 0.0 | 0.1 | 0.5 | 2.5 | 26.9 |
| | | | | | | | 0 | 0 | 30 | 0 | 15 | 16 | 19 | 9 | 3 | 4 | 19 | 12 | 3 | 8 | 1 | 6 | 6 | 10 | 13 | 0 | 2 | 4 | 10 | 0 | 0.0 | 0.1 | 0.2 | 3.3 | 26.4 |
| अक्तूबर OCT | 4.0 | 0.0 | 1.0 | 0.3 | 0.0 | 0.0 | 0 | 0 | 30 | 1 | 4 | 5 | 10 | 20 | 19 | 26 | 8 | 5 | 3 | 20 | 1 | 3 | 3 | 4 | 28 | 0 | 1 | 1 | 3 | 0 | 0.0 | 0.1 | 0.3 | 0.9 | 29.7 |
| | | | | | | | 0 | 0 | 29 | 2 | 18 | 15 | 12 | 3 | 3 | 5 | 23 | 11 | 10 | 21 | 1 | 3 | 2 | 4 | 25 | 0 | 1 | 1 | 4 | 0 | 0.0 | 0.0 | 0.3 | 0.7 | 30.0 |
| नवम्बर NOV | 0.5 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0 | 0 | 29 | 1 | 4 | 3 | 6 | 13 | 21 | 39 | 8 | 3 | 3 | 24 | 0 | 2 | 2 | 2 | 29 | 0 | 0 | 1 | 1 | 0 | 0.0 | 0.0 | 0.2 | 1.1 | 28.6 |
| | | | | | | | 0 | 0 | 28 | 2 | 25 | 11 | 5 | 1 | 2 | 7 | 23 | 15 | 11 | 25 | 0 | 1 | 2 | 2 | 28 | 0 | 0 | 1 | 1 | 0 | 0.0 | 0.0 | 0.2 | 0.4 | 29.4 |
| दिसम्बर DEC | 0.7 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0 | 0 | 30 | 1 | 2 | 2 | 4 | 11 | 23 | 41 | 9 | 5 | 3 | 24 | 0 | 2 | 3 | 2 | 30 | 0 | 0 | 0 | 1 | 0 | 0.1 | 0.1 | 0.7 | 1.5 | 28.6 |
| | | | | | | | 0 | 0 | 29 | 2 | 18 | 9 | 2 | 1 | 2 | 5 | 40 | 16 | 7 | 25 | 0 | 2 | 2 | 2 | 29 | 0 | 0 | 1 | 0 | 0 | 0.0 | 0.1 | 0.1 | 0.5 | 30.4 |
| वार्षिक ANNUAL TOTAL OR MEAN | 67.1 | 0.1 | 15.9 | 1.1 | 0.3 | 0.0 | 0 | 0 | 356 | 9 | 4 | 6 | 10 | 16 | 15 | 28 | 12 | 6 | 3 | 204 | 3 | 41 | 46 | 71 | 282 | 0 | 8 | 18 | 56 | 1 | 0.3 | 1.5 | 4.1 | 22.6 | 336.3 |
| | | | | | | | | | | | 13 | 13 | 11 | 5 | 3 | 6 | 30 | 15 | 4 | 215 | 3 | 32 | 42 | 73 | 274 | 1 | 8 | 22 | 59 | 1 | 0.0 | 1.2 | 3.1 | 19.9 | 340.8 |
| वर्षों की संख्या NUMBER OF YEARS | | | 28 | | | | | 24 | | | | | | 29 | | | | | | | | 28 | | | | | | 28 | | | | | | | |
| | | | | | | | | 24 | | | | | | 29 | | | | | | | | 27 | | | | | | 27 | | | | | | | |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**TABLE – 1**

**COAL CHARACTERISTICS**

| Sl. No. | Description | Symbol | Design Coal | Worst Coal | Best Coal | Range of Adequacy Coal |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **A.** | **PROXIMATE ANALYSIS** (As received basis) | | | | | |
| 1. | Total Moisture | % | 15.00 | 17.00 | 12.00 | 11.00-17.00 |
| 2. | Ash | % | 45.00 | 48.00 | 38.00 | 36.00-49.00 |
| 3. | Volatile matter | % | 18.00 | 17.00 | 22.00 | 23.00-17.00 |
| 4. | Fixed carbon | % | 22.00 | 18.00 | 28.00 | 30.00-17.00 |
| **B.** | **ULTIMATE ANALYSIS** (As received basis) | | | | | |
| 1. | Carbon | C% | 29.80 | 25.40 | 39.00 | 41.20-24.90 |
| 2. | Hydrogen | H2% | 3.00 | 2.80 | 3.20 | 3.30-2.60 |
| 3. | Nitrogen | N2% | 0.8 | 0.70 | 1.00 | 1.30-0.50 |
| 4. | Oxygen (By difference) | O2% | 5.4 | 5.10 | 5.70 | 6.00-5.00 |
| 5. | Sulphur | S% | 0.3 | 0.50 | 0.20 | 0.20-0.60 |
| 6. | Carbonates | CO3% | 0.50 | 0.40 | 0.60 | 0.70-0.30 |
| 7. | Phosphorous | P2% | 0.2 | 0.10 | 0.30 | 0.30-0.10 |
| 8. | Total Moisture | H2O% | 15.00 | 17.00 | 12.00 | 11.00-17.00 |
| 9. | Ash | % | 45.00 | 48.00 | 38.00 | 36.00-49.00 |
| 10. | Gross Calorific Value | KCal/Kg | 3200 | 2800 | 4000 | 4200 - 2700 |
| 11. | Hard grove index | | 55 | 50 | 60 | 65-45 |
| 12. | YGP Index | | 70 | 80 | 60 | 85-55 |
| **C.** | **ASH ANALYSIS** | | | | | |
| 1. | Silica | (SiO2)% | 58.65 | 59.00 | 58.20 | 56.9-59.20 |
| 2. | Alumina | (Al2O3)% | 28.80 | 28.00 | 29.50 | 27.70-30.00 |
| 3. | Iron Oxide | (Fe2O3)% | 5.50 | 6.00 | 4.70 | 4.50-6.50 |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

| Sl. No. | Description | Symbol | Design Coal | Worst Coal | Best Coal | Range of Adequacy Coal |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. | Titania | (TiO2)% | 1.80 | 2.00 | 1.70 | 1.50-2.10 |
| 5. | Phosphoric Anhydride | (P2O5)% | 0.70 | 0.60 | 0.90 | 0.40-0.95 |
| 6. | Lime | (CaO)% | 1.50 | 1.20 | 1.90 | 1.00-2.10 |
| 7. | Magnesia | (MgO)% | 1.30 | 1.50 | 1.20 | 1.50-2.10 |
| 8. | Sulphuric Anhydride | (SO3)% | 0.50 | 0.60 | 0.40 | 0.40-0.62 |
| 9. | Sodium Oxide | (Na2O)% | 0.10 | 0.08 | 0.30 | 0.35-0.08 |
| 10. | Balance Alkalies (By Difference) | % | 1.15 | 1.02 | 1.2 | 1.20-0.90 |
| **D.** | **ASH FUSION RANGE** (Under reducing atmosphere) | | | | | |
| a) | Initial Deformation Temperature (IDT) | °C | 1100 | 1100 | 1100 | 1150-1100 |
| b) | Hemispherical temperature | °C | 1300 | 1250 | 1350 | 1400-1250 |
| c) | Flow temperature | °C | 1400 | 1400 | 1400 | 1400-1400 |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**TABLE – 2A**

**FUEL OIL CHARACTERISTICS**

| Sl. No. | Characteristics | Heavy Furnace Oil grade HV (HFO) IS-1593-1982 | Low Sulphur Heavy Stock (LSHS) IS-11489-1985 | Heavy Petroleum stock (HPS) IS-11489-1985 |
|---|---|---|---|---|
| 1. | Total sulphur content | 4.5% Max. | 1.0% Max. | 4.5% Max. |
| 2. | Gross calorific value (KCal/kg) | of the order of 10,000 | of the order of 10,000 | of the order of 10,000 |
| 3. | Flash Point (Min) | 66 deg C | 76 deg C | 66 deg C |
| 4. | Water content by volume (Max) | 1.0% | 1.0% | 1.0% |
| 5. | Sediment by weight (Max) | 0.25% | 0.25% | 0.25% |
| 6. | Asphaltene content by weight (Max.) | 2.5% | 2.5% | 2.5% |
| 7. | Kinematic viscosity in Centistokes | 370 at 50deg C | 100 at 100deg C | 100 at 100deg C |
| 8. | Ash Content by weight (Max.) | 0.1% | 0.1% | 0.1% |
| 9. | Acidity (inorganic) | Nil | Nil | Nil |
| 10. | Pour Point (Max.) | 57 deg C | 66 deg C | 72 deg C |
| 11. | Sodium content | — | — | 100 ppm |
| 12. | Vanadium content | 25 ppm | 25ppm | 25 ppm |
| 13. | Specific heat below pour point (KCal/Kg °C) | | 0.65 | |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**TABLE – 2B**

## LIGHT DIESEL OIL CHARACTERISTICS

## AS PER IS 1460-2000

| | Characteristics | LDO |
|---|---|---|
| 1. | Pour Point (max) | 21 deg.C & 12°C for Summer and Winter respectively |
| 2. | Kinematic viscosity in centistokes at 40 deg.C | 2.5 to 15.7 |
| 3. | Sediment percent by mass (max) | 0.10 |
| 4. | Total sulphur percent by mass (max) | 1.8 |
| 5. | Ash percentage by mass (max) | 0.02 |
| 6. | Carbon residue (Rans bottom) percent by pass (max.) | 1.50 |
| 7. | Acidity in organic | Nil |
| 8. | Flash point(Min.) - Pensky Martens | 66 deg.C |
| 9. | Copper strip corrosion for 3 hours at 100°C | Not worse than No. 2 |
| 10. | Water content, % by volume(max) | 0.25 |
| 11. | GCV (Kcal/kg) | 10,000 |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**Table-3**

| S.No | Constituent | As | mg/l (except pH & turbidity) |
|---|---|---|---|
| 1. | Calcium | $CaCO_3$ | 131 |
| 2. | Magnesium | $CaCO_3$ | 52 |
| 3. | Sodium + Potassium | $CaCO_3$ | 65 |
| 4. | Total Cations | $CaCO_3$ | 248 |
| 5. | Chloride | $CaCO_3$ | 20 |
| 6. | Sulphate | $CaCO_3$ | 93 |
| 7. | Nitrate | $CaCO_3$ | 10 |
| 8. | Alkalinity | $CaCO_3$ | 125 |
| 9. | Total Anions | $CaCO_3$ | 248 |
| 10. | Iron(total) | Fe | 0.3 |
| 11. | Total Silica | $SiO_2$ | 22 |
| 12. | pH value | --- | 7.0-8.2 |
| 13. | Turbidity | NTU | 10 |

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dozing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

**Table-4**

**ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER**

| Sl.No. | Characteristics | Value |
|---|---|---|
| 1. | Silica (Max.) | 0.02 ppm as Sio2 |
| 2. | Iron as Fe | Nil |
| 3. | Total hardness | Nil |
| 4. | pH value | 6.8 -7.2 |
| 5. | Conductivity | Not more than 0.1 micro mhos/cm excluding the effects of free CO2 |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**Table-5**

**9.00.00 STEAM GENERATOR DATA**

| | | |
|---|---|---|
| 1. | Location | Outdoor |
| 2. | Operation | Base load |
| 3. | Type | Pulverised coal fired |
| 4. | Maximum Continuous Rating | 2120 Tons/hr. |
| 5. | Steam pressure at SH outlet | 255 Kg/cm² (a) |
| 6. | Steam temperature at SH outlet | 568°C |
| 7. | Oil for start-up and flame stabilisation | HFO/LSHS/HPS/LDO |
| 8. | Fuel oil system sizing | 30% of Boiler MCR for Heavy oil/ LSHS/HPS (7.5% BMCR for LDO) |
| 9. | Pulverised coal size | Minimum 70% through 200 Mesh and 99% thru 50 mesh |
| 10. | Type of pulveriser | Vertical spindle mills |
| 11. | Type of oil burners | Steam atomised, (Air atomised for LDO) |
| 12. | No. of air heaters | Two Bisector(2) for the secondary air side & Two Bisector(2) for the primary air side |
| 13. | No. of ID Fans | Two (both working) |

**10.00.00 ESP DATA**

| | | |
|---|---|---|
| 1. | Location: | Downstream side of Air preheaters |
| 2. | Operation: | Base load |
| 3. | Type: | Rigid Discharge frame |
| 4. | Rapping: | Intermittent |

| CLAUSE NO. | PROJECT INFORMATION |
|---|---|

**Table-6**

List of Drawings placed below in this sub section:

| Sl.No. | Drawing Description | Drawing No. |
|---|---|---|
| 1. | General Layout Plan | Enclosed |
| 2. | Equipment Layout Plan | Enclosed |
| 3. | ID system-Elevation & Plan | Enclosed |
| 4. | Pipe Cable Trestle Layout | Enclosed |
| 5. | Pipe Cable Trestle Foundation | Enclosed |
| 6. | Chimney foundation details | |

| | Chimney shell outer diameter at ground level (m) | Chimney foundation outer diameter (m) | Type of foundation | Level of Top of foundation (m) | Level of Bottom of foundation (m) |
|---|---|---|---|---|---|
| Unit #1 | 32 | 46.7 | Raft supported on piles | RL(+) 120.20 | RL(+) 115.95 |
| Unit #2&3 | 34.5 | 51.22 | Raft supported on piles | RL(+) 120.20 | RL(+) 115.70 |

ANNEXURE-IV

| The Designers' Consortium | SOIL PROFILE | *NTPC LTD.* | Geotechnical Investigation for New Nabinagar STPP (4x660MW) | COORDINATE 600N 2510E Elv. 120.213 | Depth of Boring (m) 35.0 | DATE from 28/6/2009 to 2/7/2009 | WATER TABLE (m) NIL | LOCATION BH-23 | SHEET 54 | ANNEX. 'A' |
|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x; Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING | RELATIVE DENSITY | SHEAR PARA - METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 1.0 | | Dark grey silty clay with kankar of high plasticity (CH) | | | | | | | | | | | | | | | | | | | | | |
| SPT | 2.0 | | | 18 | | 6 | 10 | 66 | 18 | 62 | 35 | 27 | 15 | 1.85 | 1.59 | 16.4 | 2.68 | 47 | | 0.65 | 0 | 0.69 | 0.130 | 0.15 |
| SPT | 3.0 | 3.0 | | | | | | | | | | | | | | | | | | | | | | |
| | 4.0 | | Dark grey silty clay with kankar of medium plasticity (CI) | | | | | | | | | | | | | | | | | | | | | |
| SPT | 5.0 | | | 22 | | | | | | | | | | | | | | | | | | | | |
| UDS | 6.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 7.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 8.0 | | | 27 | | | | | | | | | | | | | | | | | | | | |
| SPT | 9.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 10.0 | | | | | 5 | 13 | 73 | 9 | 45 | 28 | 17 | 12 | | | | | | | | | | | |
| SPT | 11.0 | | | 30 | | | | | | | | | | | | | | | | | | | | |
| SPT | 12.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 13.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 14.0 | | | 34 | | | | | | | | | | | | | | | | | | | | |
| SPT | 15.0 | | | | | | | | | | | | | | | | | | | | | | | |



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| The Designers' Consortium | SOIL PROFILE | *NTPC LTD.* | Geotechnical Investigation for New Nabinagar STPP (4x660MW) | COORDINATE 600N 2510E Elv. 120.213 | Depth of Boring (m) 35.0 | DATE from 28/6/2009 to 2/7/2009 | WATER TABLE (m) NIL | LOCATION BH-23 | SHEET 55 | ANNEX. 'A' |
|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING | RELATIVE DENSITY | SHEAR PARA-METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 16.0 | | Dark grey silty clay with kankar of medium plasticity (CI) | | | | | | | | | | | | | | | | | | | | | |
| SPT | 17.0 | | | 38 | | | | | | | | | | | | | | | | | | | | |
| SPT | 18.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 19.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 20.0 | | | 44 | | | | | | | | | | | | | | | | | | | | |
| SPT | 21.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 22.0 | 21.5 | Brownish poorly graded medium to coarse sand (SP) | | | | | | | | | | | | | | | | | | | | | |
| SPT | 23.0 | | | 48/27 | | | | | | | | | | | | | | | | | | | | |
| UDS | 24.0 | | | | | 0 | 96 | 4 | 0 | NON-PLASTIC | | | | 1.90 | 1.60 | 18.8 | 2.65 | | | 0.00 | 34 | 0.66 | | |
| SPT | 25.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 26.0 | | | 55/28 | | | | | | | | | | | | | | | | | | | | |
| UDS | 27.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 28.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 29.0 | | | 59/28 | | | | | | | | | | | | | | | | | | | | |
| SPT | 30.0 | | | | | | | | | | | | | | | | | | | | | | | |



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| The Designers' Consortium | SOIL PROFILE | *NTPC LTD.* | Geotechnical Investigation for New Nabinagar STPP (4x660MW) | COORDINATE 600N 2510E Elv. 120.213 | Depth of Boring (m) 35.0 | DATE from 28/6/2009 to 2/7/2009 | WATER TABLE (m) NIL | LOCATION BH-23 | SHEET 56 | ANNEX. 'A' |
|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x / Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING | RELATIVE DENSITY | SHEAR PARA-METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 31.0 | | Brownish poorly graded medium to coarse sand (SP) | | | | | | | | | | | | | | | | | | | | | |
| SPT | 32.0 | | | 61/29 | | | | | | | | | | | | | | | | | | | | |
| SPT | 33.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 34.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 35.0 | | | 67/29 | | | | | | | | | | | | | | | | | | | | |



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| The Designers' Consortium | SOIL PROFILE | *NTPC LTD.* | Geotechnical Investigation for New Nabinagar STPP (4x660MW) | COORDINATE 570N 2230E Elv. 120.501 | Depth of Boring (m) 25.0 | DATE from 4/6/2009 to 12/6/2009 | WATER TABLE (m) 13.70 | LOCATION BH-24 | SHEET 57 | ANNEX. 'A' |
|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING | RELATIVE DENSITY | SHEAR PARA-METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 1.0 | | Dark grey silty clay with kankar of high plasticity (CH) | 19 | | 6 | 13 | 66 | 15 | 63 | 34 | 29 | 14 | 1.84 | 1.59 | 15.7 | 2.68 | 45 | | 0.65 | 0 | 0.69 | 0.135 | 0.15 |
| SPT | 2.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 3.0 | | | 25 | | | | | | | | | | | | | | | | | | | | |
| | 4.0 | 4.0 | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 5.0 | | | 30 | | | | | | | | | | | | | | | | | | | | |
| UDS | 6.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 7.0 | | | 31 | | | | | | | | | | | | | | | | | | | | |
| SPT | 8.0 | | | 34 | | | | | | | | | | | | | | | | | | | | |
| SPT | 9.0 | | Dark grey silty clay with kankar of medium plasticity (CI) | 36 | | 4 | 12 | 77 | 7 | 38 | 28 | 10 | 9 | | | | | 34 | | | | | | |
| UDS | 10.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 11.0 | | | 38 | | | | | | | | | | | | | | | | | | | | |
| SPT | 12.0 | | | 40 | | | | | | | | | | | | | | | | | | | | |
| UDS | 13.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 14.0 | | | 42 | | | | | | | | | | | | | | | | | | | | |
| SPT | 15.0 | | | 44 | | | | | | | | | | | | | | | | | | | | |



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|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING | RELATIVE DENSITY | SHEAR PARA-METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 16.0 | | Dark grey silty clay with kankar of medium plasticity (CI) | | | | | | | | | | | | | | | | | | | | | |
| SPT | 17.0 | | | 38 | | | | | | | | | | | | | | | | | | | | |
| SPT | 18.0 | | | 42 | | | | | | | | | | | | | | | | | | | | |
| UDS | 19.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 20.0 | | | 47 | | | | | | | | | | | | | | | | | | | | |
| SPT | 21.0 | | Greyish poorly graded fine silty sand (SP-SM) | 52/28 | | 0 | 91 | 9 | 0 | NON-PLASTIC | | | | 1.89 | 1.61 | 17.4 | 2.66 | | | 0.00 | 32 | 0.65 | | |
| UDS | 22.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 23.0 | | | 55/28 | | | | | | | | | | | | | | | | | | | | |
| UDS | 24.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 25.0 | 25.0 | | 56/29 | | | | | | | | | | | | | | | | | | | | |



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|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING | RELATIVE DENSITY | SHEAR PARA - METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 1.0 | | Dark grey silty clay with kankar of high plasticity (CH) | | | | | | | | | | | | | | | | | | | | | |
| SPT | 2.0 | | | 22 | | | | | | | | | | | | | | | | | | | | |
| SPT | 3.0 | | | | | | | | | | | | | | | | | | | | | | | |
| | 3.5 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 4.0 | | Dark grey silty clay with kankar of medium plasticity (CI) | | | | | | | | | | | | | | | | | | | | | |
| | 5.0 | | | 24 | | | | | | | | | | | | | | | | | | | | |
| UDS | 6.0 | | | | | 7 | 13 | 65 | 15 | 43 | 24 | 19 | 12 | | | | | 37 | | 0.30 | 13 | | | |
| SPT | 7.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 8.0 | | | 30 | | | | | | | | | | | | | | | | | | | | |
| SPT | 9.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 10.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 11.0 | | | 33 | | | | | | | | | | | | | | | | | | | | |
| SPT | 12.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 13.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 14.0 | | | 36 | | | | | | | | | | | | | | | | | | | | |
| SPT | 15.0 | | | | | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x / Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING | RELATIVE DENSITY | SHEAR PARA - METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 16.0 | | | | | 7 | 15 | 73 | 5 | 38 | 23 | 15 | 9 | 1.85 | 1.58 | 17.1 | 2.66 | 34 | | 0.25 | 17 | 0.68 | 0.118 | 0.1 |
| SPT | 17.0 | | Dark grey silty clay with kankar of medium plasticity (CI) | 39 | | | | | | | | | | | | | | | | | | | | |
| SPT | 18.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 19.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 20.0 | | | 41 | | | | | | | | | | | | | | | | | | | | |
| SPT | 21.0 | 21.0 | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 22.0 | | Brownish poorly graded medium to coarse sand (SP) | | | | | | | | | | | | | | | | | | | | | |
| SPT | 23.0 | | | 45/23 | | | | | | | | | | | | | | | | | | | | |
| UDS | 24.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 25.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 26.0 | | | 47/23 | | | | | | | | | | | | | | | | | | | | |
| SPT | 27.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 28.0 | | | | | 0 | 95 | 5 | 0 | NON-PLASTIC | | | | 1.89 | 1.61 | 17.4 | 2.65 | | | 0.00 | 33 | | | |
| SPT | 29.0 | | | 49/25 | | | | | | | | | | | | | | | | | | | | |
| SPT | 30.0 | 30.0 | | 54/26 | | | | | | | | | | | | | | | | | | | | |



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|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING(%) | RELATIVE DENSITY | SHEAR PARA - METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 1.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 2.0 | | Dark grey silty clay with kankar of high plasticity (CH) | 18 | | 3 | 15 | 68 | 14 | 58 | 33 | 25 | 13 | 1.80 | 1.58 | 13.9 | 2.67 | 45 | | 0.60 | 0 | 0.69 | 0.128 | 0.2 |
| SPT | 3.0 | | | | | | | | | | | | | | | | | | | | | | | |
| | 4.0 | 4.0 | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 5.0 | | | 27 | | | | | | | | | | | | | | | | | | | | |
| UDS | 6.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 7.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 8.0 | | | 31 | | | | | | | | | | | | | | | | | | | | |
| SPT | 9.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 10.0 | | Dark grey silty clay with kankar of medium plasticity (CI) | | | 5 | 17 | 71 | 7 | 41 | 22 | 19 | 9 | | | | | | | | | | | |
| SPT | 11.0 | | | 33 | | | | | | | | | | | | | | | | | | | | |
| SPT | 12.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 13.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 14.0 | | | 35 | | | | | | | | | | | | | | | | | | | | |
| SPT | 15.0 | | | | | | | | | | | | | | | | | | | | | | | |



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| The Designers' Consortium | SOIL PROFILE | *NTPC LTD.* | Geotechnical Investigation for New Nabinagar STPP (4x660MW) | COORDINATE 850N 1965E Elv. 120.246 | Depth of Boring (m) 30.0 | DATE from 30/6/2009 to 5/7/2009 | WATER TABLE (m) NIL | LOCATION BH-26 | SHEET 62 | ANNEX. 'A' |
|---|---|---|---|---|---|---|---|---|---|---|

| TYPE OF SAMPLES | DEPTH BELOW NGL (m) | SUB SOIL PROFILE | SOIL DESCRIPTION AND ITS CLASSIFICATION | SPT 'N' VALUES | PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80) | GRAIN SIZE DISTRIBUTION: GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | ATTERBERGS' LIMIT: LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | SHRINKAGE LIMIT | DENSITY (gm/cm$^3$): BULK DENSITY | DRY DENSITY | NATURAL MOISTURE CONTENTS (%) | SPECIFIC GRAVITY | FREE SWELLING | RELATIVE DENSITY | SHEAR PARA - METER: COHESION C (Kg/cm$^2$) | FRICTION ANGLE f | CONSOLI-DATION PARAMTR.: VOID RATIO $e_0$ | COMPRESSION INDEX $C_c$ | SWELLING PRESSURE (Kg/cm$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UDS | 16.0 | | Dark grey silty clay with kankar of medium plasticity (CI) | 35 | | | | | | | | | | | | | | | | | | | | |
| SPT | 17.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 18.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 19.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 20.0 | | | 38 | | | | | | | | | | | | | | | | | | | | |
| SPT | 21.0 | | | | | | | | | | | | | | | | | | | | | | | |
| UDS | 22.0 | 22.0 | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 23.0 | | Dark brown poorly graded fine silty sand (SP-SM) | 40/25 | | | | | | | | | | | | | | | | | | | | |
| UDS | 24.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 25.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 26.0 | | | 45/26 | | | | | | | | | | | | | | | | | | | | |
| UDS | 27.0 | | | | | 0 | 94 | 6 | 0 | NON-PLASTIC | | | | 1.89 | 1.61 | 17.4 | 2.65 | | | 0.00 | 33 | 0.65 | | |
| SPT | 28.0 | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 29.0 | | | 48/26 | | | | | | | | | | | | | | | | | | | | |
| SPT | 30.0 | 30.0 | | 55/27 | | | | | | | | | | | | | | | | | | | | |



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TO SONE RIVER

365.40E 3852.60N

ASH SLURRY PIPE CORRIDOR-I

MAKE-UP WATER PIPE CORRIDOR

ASH SLURRY PIPE CORRIDOR-II

WIND ROSE

N NE E SE S SW W NW

100 M WIDE TRANSIMISSION LINE CORRIDOR

TRANSMISSION LINE CORRIDOR

Barun Nabinagar Road

VILLAGE DIVERSION ROAD

MAIN DRAIN

GREEN BELT

WORKSHOP

SPACE FOR LAYDOWN

O&M STORES

CANTEEN

AUDITORIUM

GUEST HOUSE

GATE COMPLEX

PLANT APPROACH

ROAD TO RAGHUNATHPUR VILLAGE

RAIL CULVERT (TYP.)

ROAD CULVERT (TYP.)

STAGE-I ASH SLOS

SPACE FOR LAY DOWN AND PRE-ASSEMBLY

SPACE FOR F.O.D.

TRUNK DRAIN

RAW WATER RESERVOIR-1

RAW WATER RESERVOIR-2

TOP OF RESERVOIR EMBANKMENT RL122.50

DIVIDE EMBANKMENT

INLET-1 INLET-2 OUTLET-1 OUTLET-2 SPILLWAY-1 SPILLWAY-2

TO BE MATCHED SUITABLY WITH EXISTING ROAD

CRUSHED COAL STOCK PILE-1 CRUSHED COAL STOCK PILE-2 CRUSHED COAL STOCK PILE-3 CRUSHED COAL STOCK PILE-4 CRUSHED COAL STOCK PILE-5 CRUSHED COAL STOCK PILE-6 CRUSHED COAL STOCK PILE-7 CRUSHED COAL STOCK PILE-8

CONV. 5A/5B CONV. 1A/1B CONV. 2A/2B CONV. 3A/3B CONV. 4A/4B CONV. 144/148

SPACE FOR LAYDOWN & PRE ASSEMBLY

F.O. TRANSFER/ FORWARDING & P.H.

SWITCH YARD AREA STAGE-II (765KV)

TOWNSHIP (185 ACRES)

100M WIDE GREEN BELT

SPACE FOR LAYDOWN & PRE-ASSEMBLY

CONSTRUCTION OFFICE CONSTRUCTION STORES STEEL STORAGE YARD RL(+)121.2M

RAW WATER RESERVOIR-1 RAW WATER RESERVOIR-2 SPILLWAY INLET OUTLET

RWPH

DOZER SHED

SPACE FOR F.G.D.

TO BRBCL

CO-ORDINATES RECIEVED FROM SITE

52.966N 302.333E
48.257N 951.444E
43.375N 1459.645E
39.573N 1947.630E
2421.0E 40.10N
35.016N 2438.479E
770.925N 2417.979E
702.529N 360.123E

0 40 80 120 160 200M
SCALE

200mm THICK - 63mm TO 45mm GRADED HARD STONE AGGREGATE INCLUDING FILLING THE INTERSTICES OF STONE AGGREGATE WITH MOORUM (ITEM NO.- 9(a) (II))

EL (-) 0.45M

COMPACTED SUB GRADE (ORIGINAL SUBGRADE TO BE COMPACTED TO 85% OF STANDARD PROCTOR DENSITY)

**TYP DETAIL OF HARD CRUSTING IN BOILER AREA**

NOTES:

1. ALL DIMENSIONS AND LEVELS ARE IN METRES.
2. FOR DETAILS IN MAIN PLANT BLOCK REFER MAIN PLANT LAYOUT DRAWING NO. 0270-999-POM-F-001.
3. FORMATION LEVEL OF THE PROJECT SITE IS AS SHOWN FOR VARIOUS BLOCKS
4. ELEVATION 0.00 CORRESPONDS TO MAIN POWER HOUSE RL(+)121.7M.
5. THE AREA IDENTIFIED FOR LAYDOWN, PRE-ASSEMBLY, OFFICES & STORES ETC. IS TO BE SHARED BY THE VARIOUS CONTRACTING/SUB CONTRACTING AGENCIES ENGAGED BY THE OWNER. THE LOCATION & THE EXTENT OF AREA ALLOTTED TO EACH AGENCY WILL BE DECIDED BY THE OWNER'S SITE ENGINEER CONSIDERING THE AREA REQUIREMENT OF VARIOUS AGENCIES AND THEIR RESPECTIVE WORK AREA LOCATIONS. IT IS LIKELY THAT THE AREA ALLOTTED TO EACH BIDDER MAY NOT BE FULLY AS PER HIS REQUIREMENT AND/OR THE AREA MAY BE AWAY FROM HIS AREA OF WORK.
6. THE SWITCH YARD STRUCTURAL ARRAGMENT SHOWN IS FOR GUIDENCE AND INDICATIVE AND SHALL BE PROVIDED AS REQUIRED DURING DETAILS ENGINEERING
7. COORDINATE MARKED WITH (*) ARE COORDINATE OF LAND ACQUISITION LINE RECIVED FROM SITE.

LEGEND:

1. ROADS (DOUBLE LINE) / ROADS (SINGLE LINE)
2. BOUNDARY WALL
3. FENCING
4. RAIL TRACK
5. WATCH TOWER
6. FORMATION LEVEL — RL(+)121.2M
7. FACILITIES/BUILDING/STRUCTURE (STAGE-I)
8. FACILITIES/BUILDING/STRUCTURE (STAGE-II)
9. LAND ACQUISITION LINE

| REV.NO. | DESCRIPTION | DRAWN | DESIGN | CHKD. | M | E | C | C&I | ES | APPD | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | MECH. COMMENTS INCORPORTED & GENERAL UPDATION | Manoj | | | | | | – | – | | 17.04.15 |
| 8 | FINAL INPLANT RAILWAY SIDING LAYOUT SUPERIMPOSED | Manoj | | | | | | – | – | | 14.01.15 |
| 7 | (a) STAGE-I ACCOMMODATED WITHIN LAND DEMARCATION GIVEN BY SITE. (b) GENERALLY UPDATED. (c) CHP IN LINE WITH NIT RETAINED. | Manoj | RV | RB | SM AKM DB DH | SSM | RB | – | – | AVR | 22.02.13 |
| 6 | AS SUGGESTED BY SITE, STAGE-I (3X660 MW) AND STAGE-II (3X660 MW) FACILITIES SWAPPED AND CHP LAYOUT REVISED. | Raj | AP | RB | JGG | SSM | RB | – | – | AVR | 12.12.12 |
| 5 | CAPACITY REVISED FROM 2X660MW TO 3X660 MW ST-II | Raj | AP | RB | | | | | | | 05.04.12 |
| 4 | REVISED BASED ON LAND ACQUISITION LINE RECEIVED FROM SITE DATED 10.10.2011 | Raj | AP | RB | | | | | | | 03.11.11 |
| 3 | SWITCH YARD, CHP & WTP MODIFIED | Raj | AP | RB | | | | | | | 18.03.11 |
| 2 | FO FACILITIES FOR STAGE-II & AUX. BOILER ADDED | Raj | AP | RB | AG | SSM | SMK | — | – | SR | 08.01.10 |
| 1 | MAIN PLANT BLOCK MODIFIED | Prayag | AP | RB | AG | SSM | SMK | — | – | SR | 23.12.09 |
| 0 | FOR TENDER PURPOSE ONLY. | Prayag | AP | RB | PA | | SMK | – | - | | 25.09.09 |

CLEARED BY

FOR TENDER PURPOSE ONLY

OWNER: NABINAGAR POWER GENERATING CO. PVT. LTD.

CONSULTANT: एन टी पी सी NTPC — **NTPC Limited** (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION

PROJECT: NABINAGAR SUPER THERMAL POWER PROJECT (3X660MW+3X660MW)

TITLE: GENERAL LAYOUT PLAN

| SIZE | SCALE | DRG. NO. | REV. NO. |
|---|---|---|---|
| A0 | 1 : 4000 | 0370-999-POC-F-001 | 9 |

FILE: 0370-999-POC-F-001

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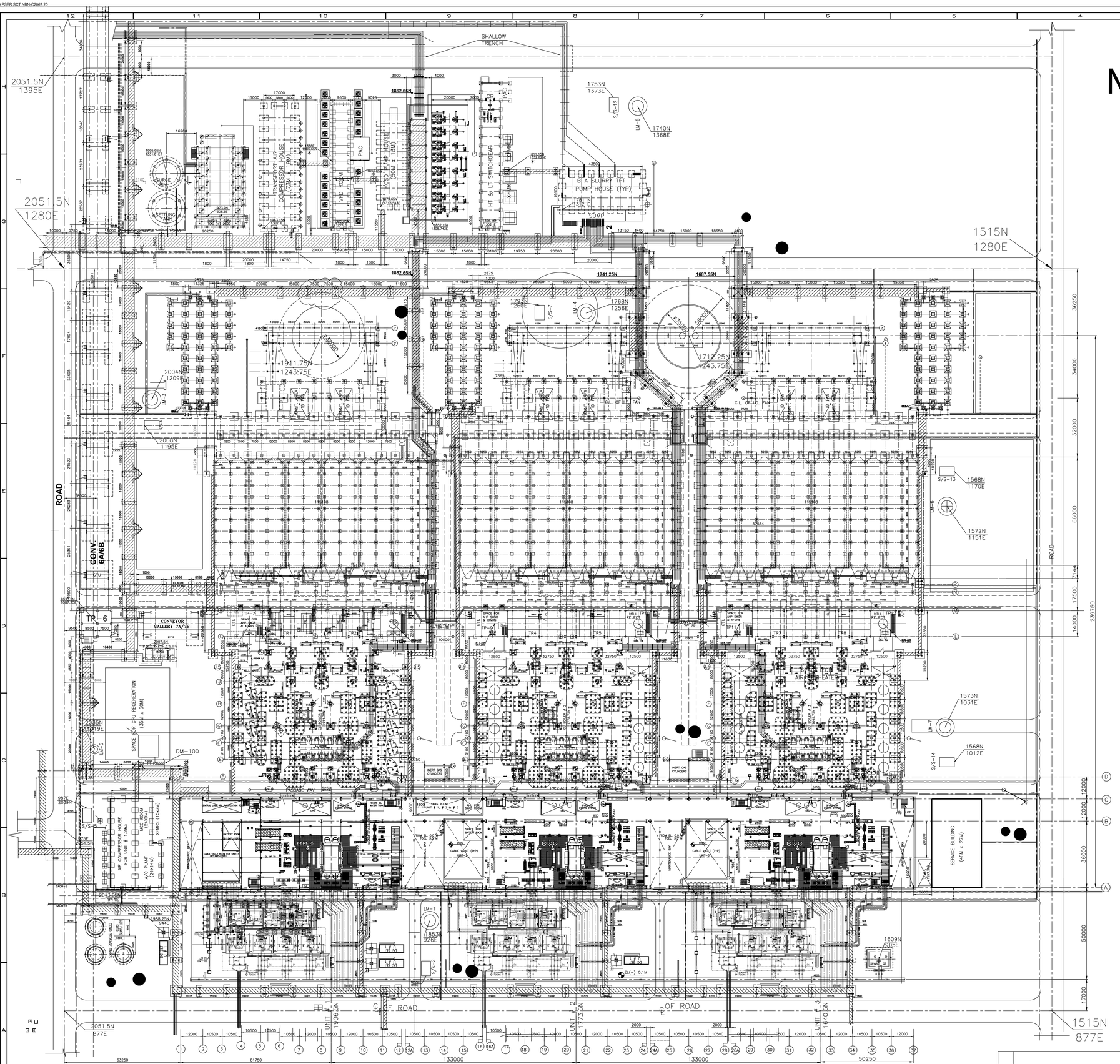


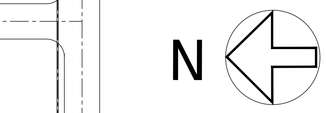


## LEGEND

- PIPE HATCH
- VERTICAL BRACING
- FPD — FIRE PROOF DOOR
- GRATING
- CHEQUERED PLATE
- R — REMOVABLE
- HAND RAILING
- PIPE & CABLE TRESTLE
- FIRE BARRIER WALL

## NOTES:–

1. THE EQUIPMENT SHALL BE GENERALLY IN ACCORDANCE WITH THE LAYOUT AND DIMENSIONAL REQUIREMENTS INDICATED IN THESE DRAWINGS. HOWEVER BUILDING SIZES INDICATED ARE MINIMUM REQUIREMENT AND ACTUAL SIZE SHALL BE AS PER FUNCTIONAL REQUIREMENT BUT NOT LESS THAN THOSE INDICATED IN THESE DRAWINGS.
2. NO PIPES, CABLES, STRUCTURES ARE TO BE PLACED BELOW 7.0M (BOP, BOC OR BOS) IN FRONT OF BOILER BETWEEN THE 12.0M CORRIDOR SEPARATING MAIN PLANT AND FIRST ROW OF BOILER COLUMNS (i.e. CD BAY) EXCEPT IN CONTROL TOWER AREA.
3. LOCATION OF DOORS/REMOVABLE COVERS SHOWN IN THE DRAWINGS ARE INDICATIVE AND SHALL BE FINALISED DURING DETAILED ENGINEERING.
4. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
5. FIRE BARRIER WALL IS PROVIDED ON A–ROW BETWEEN AXIS NO. 2–8,14–20 & 26–32.
6. ALL ELEVATIONS INDICATED IN THE DRG ARE w.r.t. T.G. BUILDING GROUND FLOOR ELEVATION AS(±)0.00M.
   i) FINISHED FLOOR OF PAVING SLAB IN BOILER/ESP/ID FAN AREA SHALL BE (–)0.2M
   ii) FINISHED FLOOR ELEVATION IN MILL BAY AT GROUND LEVEL SHALL BE 0.00M.
   iii) FINISHED FLOOR LEVEL IN X–FMR YARD SHALL BE (–) 0.10M.
   iv) FINISHED FLOOR LEVEL INSIDE CHIMNEY SHALL BE 0.00M.
   v) FINISHED FLOOR LEVEL IN THE VARIOUS BUILDINGS IN MAIN PLANT AREA SHALL BE 0.00M.
7. ALL CABLE SPREADER ROOMS TO BE PROVIDED WITH DRAINAGE ARRANGEMENT.
8. BOTTOM OF STEEL OF PIPE / CABLE RACK IN MILL BAY AREA SHALL BE MINIMUM EL 17.0M.
9. FOR FLY ASH HANDLING EITHER VACUUM PUMPS OR EXTRACTION AIR COMPRESSORS SHALL BE PROVIDED.
10. IN CASE OF VACUUM PUMPS FOR DRY ASH SYSTEM, THESE SHALL BE LOCATED BELOW ESP NEAR IT'S 1ST FIELD AND THE SWGR. ROOM FOR THE SAME ALONG WITH TRANSFORMERS SHALL BE LOCATED IN ONE OF THE MAIN PLANT TP. IN CASE OF EXTRACTION AIR COMPRESSORS, THESE ALONG WITH SWGR. ROOM SHALL BE LOCATED IN AHP AREA, ACROSS THE ROAD BEHIND CHIMNEY.
11. BRICK WALL REQUIREMENTS :
    i) ALL STAIRCASES AT 'A' ROW & 'C' ROW SHALL BE PROVIDED WITH 230 mm THICK BRICK ENCLOSURE.
    ii) ALL CABLE SPREADER ROOM WALLS.
    iii) WALLS OF SWAS ROOM.
    iv) HT/LT SWITCH GEAR ROOMS, BOILER MCC ROOM.
    v) AIR HANDLING UNITS(AHU).
    vi) OIL EQUIPMENT ROOM .
12. RCC WALL : 250 mm THK RCC WALL FROM EL 0.0M TO 0.6M FOR LUBE OIL ROOM.
13. D–ROW IS THE FIRST ROW OF BOILER AND MILL BAY COLUMNS.
14. RAIN WATER PIPES SHALL BE ROUTED INSIDE THE COLUMN DEPTH IN ELECTRICAL BAYS AND IP BUSDUCT BAY.
15. EL 0.0M CORRESPONDS TO RL (+) 121.7 M.
16. LOCATION AND SIZES OF TRANSFORMERS SHOWN IN TRANSFORMER YARD IS INDICATIVE ONLY.
17. NO VERTICAL BRACING IN ELECTRICAL BAY AND I.P. BUS DUCT BAY SHALL BE PROVIDED.
18. GLP TENDER DRAWING IS TO BE REFERRED FOR AVAILABLE SPACE FOR FGD SYSTEM.

FOR FGD TENDER PURPOSE ONLY

| REV. | DESCRIPTION | DRAWN | DESIGN | CHKD. | L/O | E | C | C&I | APPD | DATE |
|---|---|---|---|---|---|---|---|---|---|---|
| A | FOR FGD TENDER PURPOSE ONLY | PA | | | | | | | | 22.06.17 |

एन टी पी सी लिमिटेड
**NTPC Limited**
( A GOVT. OF INDIA ENTERPRISE )
ENGINEERING DIVISION

PROJECT: **NEW NABINAGAR SUPER THERMAL POWER PROJECT** (3x660MW)

TITLE: EQUIPMENT LAYOUT PLAN AT EL 0.00M.

| SIZE | SCALE | DRG.NO. | REV. |
|---|---|---|---|
| A–0 | 1.1 | 0370-999-POM-A-001 | A |

cad file name : 0370–999–POM–A–001 dwg. (22–06–2017)

| | | |
|---|---|---|
| Maharatna Company | **TITLE: - 4X250 MW BRBCL NABINAGAR FGD**<br>**SPECIFICATION FOR RCC CHIMNEY** | SPECIFICATION NO. PE-TS-463-620-C002<br>VOLUME :<br>SECTION :<br>REV.NO. 00<br>SHEET : |

# 4X250 MW BRBCL NABINAGAR STPP
# FGD SYSTEM PACKAGE

## VOLUME II-B

## CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

## SECTION – D

## GENERAL TECHNICAL REQUIREMENTS

## (RCC CHIMNEY)

## SPECIFICATION NO. PE-TS-463-620-C002

## REV-00

Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**Power Sector, PPEI BUILDING, Plot No-25**
**SECTOR 16A, NOIDA-201301, UP**

| | | |
|---|---|---|
| Maharatna Company | **TITLE: - 4X250 MW BRBCL NABINAGAR FGD**<br>**SPECIFICATION FOR RCC CHIMNEY** | SPECIFICATION NO. PE-TS-463-620-C002<br>VOLUME :<br>SECTION :<br>REV.NO. 00<br>SHEET : |

## PREAMBLE

Standard technical details as indicated in specification shall be agreed upon between BHEL & Bidder.

Technical requirements are stipulated in this Volume which comprises of

Section C : This section indicates the technical requirements specific to the contract not covered in Section D

Section D : This section comprises of technical specification(s)

The requirements mentioned in the Section C shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the Section D in the specification. In case on any conflict between technical specification and BOQ, BOQ shall prevail.

| | | |
|---|---|---|
| Maharatna Company | **TITLE: - 4X250 MW BRBCL NABINAGAR FGD**<br>**SPECIFICATION FOR RCC CHIMNEY** | SPECIFICATION NO. PE-TS-463-620-C002<br>VOLUME :<br>SECTION :<br>REV.NO. 00<br>SHEET : |

# INDEX

**SECTION** **DESCRIPTION**

**Section-C** **SPECIFIC TECHNICAL REQUIREMENTS**

i) CIVIL
ii) ELECTRICAL
iii) Chimney Elevator

**Section-D** **SPECIFICATION FOR CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS**

Sub-section D1: Earthwork in excavation and backfilling

Sub-section D2: Cement concrete (Plain and reinforced) and formwork

Sub-section D3: Carpentry and joinery

Sub-section D4: Roof and underground structures water proofing, insulation and allied works

Sub-section D5: Metal doors, windows, ventilators, louvers etc.

Sub-section D6: Glass and glazing.

Sub-section D7: Rolling Steel Shutter and Grills

Sub-section D8: Miscellaneous Metal

Sub-section D9: Masonry and allied works

Sub-section D10: Finish to masonry and concrete

Sub-section D11: Painting, Whitewashing, polishing

Sub-section D12: Floor finish and allied works

Sub-section D13: Sheet work in roof and siding

Sub-section D14: Suspended ceiling

Sub-section D15: Water supply, drainage & sanitation

Sub-section D16: Road and drainage

Sub-section D17: Fabrication of structural steelwork

Sub-section D18: Erection of structural steelwork

Sub-section D19: Roof decking

| | | |
|---|---|---|
| Maharatna Company | **TITLE: - 4X250 MW BRBCL NABINAGAR FGD**<br>**SPECIFICATION FOR RCC CHIMNEY** | SPECIFICATION NO. PE-TS-463-620-C002<br>VOLUME :<br>SECTION :<br>REV.NO. 00<br>SHEET : |

Sub-section D20: False flooring

Sub-section D21: Bored cast in situ RCC pile

Sub-section D22: Levelling and grading

Sub-section D23: Anti termite

Sub-section D24: Quality Assurance & Inspection

Sub-section D25: RCC stack

Sub-section D26: Borosilicate glass block lining system

Sub-section D27: Specification for electrical works.

Sub-section D28: specification for chimney elevator

| | TITLE: TECHNICAL SPECIFICATION FOR EARTHWORK IN EXCAVATION AND BACKFILLING | SPECIFICATION NO. PE-TS-999-600-C001 |
|---|---|---|
| | | VOLUME - II B |
| | | SECTION - D \| SUB-SECTION – D1 |
| | | REV.NO. 00 DATE 21/09/2017 |
| | | SHEET 1 OF 23 |

# VOLUME: II B

## SECTION - D

### SUB-SECTION – D1

## EARTHWORK IN EXCAVATION AND BACKFILLING

## SPECIFICATION NO. PE-TS-999-600-C001

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.0 | SCOPE | 3 |
| 2.00.00 | GENERAL | 3 |
| 3.00.00 | EXECUTION | 6 |
| 4.00.00 | TESTING AND ACCEPTANCE CRITERIA | 19 |
| 5.00.00 | RATES AND MEASUREMENTS | 19 |
| 6.00.00 | INFORMATION TO BE SUBMITTED BY THE BIDDER | 20 |

# STANDARD TECHNICAL SPECIFICATION FOR EARTHWORK IN EXCAVATION AND BACKFILLING

## 1.0.0 SCOPE

This specification covers earth work excavation in all types of soil, soft rock and hard rock including setting out, clearing and grubbing, shoring, dewatering, back filling around foundations/pipelines to grade, watering, compaction of fills, testing, approaches, disposal of surplus earth, protective fencing, lighting etc relevant to the structures and locations covered under this contract.

## 2.0.0 GENERAL

### 2.1.0 Work to be provided for by the Contractor

The work to be provided for by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision services, earth moving machineries, surveying instruments including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.

b) Preparation and submission of working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering including drainage, space for temporary stacking of soils, disposal area, fencing etc and all other details as may be required by the engineer.

c) To carry tests and submit to the Engineer, test results of fill materials and degree of soil compaction of fill whenever required by the Engineer to assess the quality of fill.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc. including procurement of necessary licenses from proper authorities.

### 2.2.0 Work to be provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

**2.3.0 Codes and Standards**

All works shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes unless specified otherwise.

| | |
|---|---|
| IS-1200 | Method of measurement of building and civil engineering works, Part-I: Earthwork |
| IS-2720 | Method of test for soils (Relevant parts) |
| IS-3764 | Excavation work - Code of safety |
| IS-4081 | Safety code for blasting and related drilling operations |
| IS-4701 | Indian Standard Code of Practice for earthwork on Canals |
| IS:6922 | Criteria for safety and design of structures subject to underground blasts |
| IS: 3764 | Excavation work – code of safety |

In case of conflict between this specification and those (IS Codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by this specification/IS Codes, any other standard practice as may be specified by the engineer shall be followed.

**2.4.0 Conformity with Designs**

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

**2.5.0 Materials**

**2.5.1 General**

All materials required for the work shall be of the best commercial variety and approved by the engineer.

**2.5.2 Material for Excavation**

For the purpose of identifying the various strata encountered during the course of excavation, refer clause no. 3.4.0 for the classification of earth strata.

**2.5.3 Material for Filling**

Material to be used for back filling shall be free from vegetations, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc and shall be got approved by the engineer. Normally excavated earth shall be used for back filling. In case such earth contains deleterious salts, the same shall not be used. All clods of earth shall be broken or removed. Where the excavated material is mostly rock and if filling with the same is permitted by the engineer engineer in writing, then the filling with rock shall be done in the following

manner. The boulders shall be broken into pieces not exceeding 150mm size in in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as for as possible and the mixture shall then be used for filling.

In case the earth required for backfilling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. The selected earth from the borrow areas shall be got approved by the engineer. The borrowed material shall be free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods etc. The contractor shall obtain and submit necessary clearances/permissions from the concerned authorities for the borrow areas/materials acquired to the engineer.

If specified, the back filling shall be done with clean well graded sand from approved quarries free from harmful and deleterious materials.

**2.6.0 Quality Control**

All works shall confirm to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

| Sl. No. | Activity | Check |
|---|---|---|
| 1 | Lines, levels & grades | a) By periodic surveys<br>b) By establishing markers, boards etc |
| 2 | Back filling | (a) On quality of fill material<br>(b) On moisture content of back fill<br>(c) On degree of compaction achieved |

**2.7.0 Information regarding site conditions**

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction

likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

## 3.0.0 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and back filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of slopes, shoring, approaches, dewatering, drainage, berms etc. for the approval of engineer.

### 3.1.0 Setting out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the same shall be rectified by the contractor at his own risk and cost.

### 3.2.0 Initial Levels

Initial levels of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. All records of levels, measurements etc. and also any drawing, cross-section etc. made therefrom, shall be jointly signed by the authorised representative of the contractor and the Engineer before the commencement of work and they shall form the basis of all payments in future.

### 3.3.0 Clearing and Grubbing

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Trees upto 300mm girth shall be uprooted. Trees above 300mm girth to be cut shall be approved by the engineer and marked. Cutting of trees shall include removing roots as well. After the tree is cut and roots taken out, the pot holes formed shall be filled with good earth in 250mm layers and compacted unless directed otherwise by the engineer. The trees shall be cut in to suitable pieces as instructed by the

engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timber, fire woods etc shall be the property of the owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

### 3.4.0 Classification

All earthwork shall be classified under the following categories:

No distinction will be made whether the material is dry or wet.

a) **Ordinary Soil**

This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) **Hard Soil**

This shall include :
i) stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;
ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;
iii) soling of roads, paths, etc., and hard core ;
iv) macadam surfaces such as water bound, and bitumen/tar bound;
v) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;
vi) soft conglomerate, where the stones may be detached from the matrix with picks ; and
vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.

c) **Soft and Decomposed Rock**

This shall include :
i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;
ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded

in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and
iv) any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.

d) **Hard Rock (requiring blasting)**

This shall include :
i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ;
ii) reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and
iii) boulders requiring blasting.

**e) Hard Rock (blasting prohibited)**

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

## 3.5.0 Excavation for Foundations and Trenches

### 3.5.1 General

All excavation shall be done to the minimum dimensions as required for the safety and working facility. In each individual case, the contractor shall obtain prior approval of the engineer for the method he proposes to adopt for the excavation including dimensions, side slopes, shoring, dewatering, drainage and disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. All excavation in open cuts shall be made true to the line, slopes and grades as shown on the drawings and/or as directed by the engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders (if any) projecting out of the excavated surfaces shall be removed if they are likely to be a hindrance to the work/workers in the opinion of the engineer.

Method of excavation shall in every case be subject to the approval of the engineer. The contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works etc including the safety of the workmen. If any slip occurs, the contractor shall remove all the slipped materials from the excavated pit without any extra cost to the engineer/owner. All loose boulders and semi detached rocks which are not inside but so close to the area to be excavated and may liable to fall or otherwise endanger the

workmen, equipment of the work etc during excavation in the opinion of the engineer shall be stripped off and removed away from the area of excavation. The method to be used for removal shall be such that it should not shatter or render unstable or unsafe the portion which was originally sound and safe. In case any material not required to be removed initially but later to become loose loose or unstable in the opinion of the engineer shall also be promptly and satisfactorily removed.

The rough excavation may be carried out upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the engineer. If the excavation (in all types of soil and rock) is done to a depth greater than that shown on the drawing or as directed by the engineer, the excess depth up to the required level shall be filled with cement concrete not leaner than 1:4:8 or richer as directed by the engineer at the own risk and cost of the contractor. In case where excavation in soil, soft rock (including weathered rock) and hard rock are involved, the excavation in each stratum shall be carried out separately with the approved methodology and as per the instructions of the engineer.

All excavated materials such as rock, boulders, bricks, dismantled concrete blocks etc shall be the property of the owner and shall be stacked separately as directed by the engineer. All gold, silver, oil, minerals, archeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the owner and the contractor shall duly preserve the same to the satisfaction of the engineer/owner. The contractor shall deliver the same to such person or persons as may be authorized or appointed from time to time by the owner to receive the same.

**Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.**

### 3.5.2 Excavation in All Type of Soil and in Soft Rock

The excavation in all type of soil, soft rock including decomposed rock etc shall be carried out as per the approved proposal and as directed by the engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. Foundation pits shall not be excavated to the full depth unless construction is imminent. The last 150mm 150mm depth shall be excavated once concreting work is imminent. At the discretion of the engineer, the full depth may be excavated and the bed be covered with lean concrete as specified after watering and compacting the bed. As the excavation reaches the required dimensions, lines, levels and grades etc,

etc, the work shall be got checked and approved by the engineer. In cases where deterioration of the ground, upheaval, slips etc are expected, the engineer may order to suspend the work at any stage and instruct the contractor to carry out the protection works before the excavation will be restarted.

### 3.5.3 Excavation in Hard Rock

Hard rocks shall normally be excavated by means of blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is not stable against sliding, necessary supports such as props, bracings or bulkheads shall be provided and maintained during the period of construction. Where the danger of falling loose rock/boulder from the excavated surfaces deeper than 2m exist, steel mesh anchored to the lower edge of the excavation and extending over and above the rock face adequate to retain the dislodged material shall be provided and maintained.

### 3.5.4 Blasting

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.

### 3.5.4.1 Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

### 3.5.4.2 Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine. Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine.

Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be

provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

* not to touch the magazine shoes on ground outside the clean floor.

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

### 3.5.4.3 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

### 3.5.4.4 Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his

responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

**3.5.4.5 Restrictions in Blasting**

a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
e) The last blast shall not be more than 0.50 m in depth.
f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

**3.5.5 Disposal**

The excavated spoils shall be disposed of in any (or all) of the following manner as directed by the engineer.

a) By using it straightway for backfilling.

b) By stacking it temporarily to use for backfilling at a later date during execution of the contract.

c) i) By either spreading
or
ii) By spreading and compacting at designated disposal areas.

a) By selecting the useful material and stacking it neatly in designated areas as indicated by the engineer for use in backfilling by some other agency.

**3.5.6 Disposal of Surplus Materials**

All surplus material from excavation shall be removed and disposed of from the excavation site to the designated disposal area indicated by the engineer.

All good and sound rocks obtained from excavations and all assorted materials of dismantled structures are the property of the owner and if the contractor wants to use it, he shall have to obtain it from the engineer at a mutually agreed rate. All sound rocks and other assorted materials like excavated bricks etc shall be stacked separately.

### 3.5.7 Protection

The contractor shall notify the engineer as soon as the excavation is expected to be completed within a day so that he shall inspect it at the earliest. Immediately after approval of the engineer, the excavation must be covered up in a shortest possible time. But in no case the excavation shall be covered up or worked on before approval by the engineer. Excavated material shall be placed 1.5m or half the depth (of excavation) whichever is more from the edge of the excavation or further away if directed by the engineer. Excavation shall not be carried out below the foundation level of the structure close by until the required precautions are taken. Adequate fencing is to be made enclosing the excavation. The contractor shall protect all the underground services exposed during excavation. All existing surface drains in the work area shall be suitably diverted by the contractor before taking up excavation to maintain the working area neat and clean.

### 3.5.8 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably praticable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

No works shall commence until surface water streams have been properly intercepted , redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems to drain surface water from working areas.

### 3.5.9 Dewatering

All excavation shall be kept free of water and slush. Grading in the vicinity shall be controlled to prevent the surface water running into the excavations. The contractor shall remove any water inclusive of rain water and subsoil water etc accumulated in the excavation by pumping or other means as approved by the engineer and keep the excavations dewatered and/or lower the subsoil water level to 300mm below the founding level until the construction of foundation and backfilling are completed in all respects.

Sumps made for dewatering must be kept clear of the foundations. The engineer’s prior approval on the method of pumping to be adopted shall be

taken; but in any case, the pumping arrangement shall be such that there shall be no movement or blowing in of subsoil due to the differential head of water during pumping.

### 3.5.10 Timber Shoring

Close or open type timber shoring as approved by the engineer depending on the nature of sub-soil, depth of pit or trench and the type of timbering shall be adopted. Timbers made out of approved quality shall only be used. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

### 3.5.10.1 Close Timbering

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called "polling boards". These shall be of 250mm wide(min.) and 40mm thick(min.) sections as directed by the engineer. The boards shall generally be placed vertically in pairs, one on each side of the cut and shall be kept apart (maximum spacing is limited to 1.20m ) by horizontal walers of strong wood cross strutted with wooden struts or as directed by the engineer. The length of wooden struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of excavation and supported by vertical walers which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed to avoid any slipping out of earth.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started from one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

### 3.5.10.2 Open Timbering

In case of open timbering, vertical board of 250mm wide(min.) and 40mm thick(min.) shall be spaced sufficiently apart to leave unsupported strips of maximum 500mm average width. The detailed arrangement, size of timber and the spacing etc shall be subjected to the approval of the engineer. In all other respects, the specification for close timbering shall apply to open timbering as well.

**3.6.0 Treatment of Slips**

The contractor shall take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides of the excavations. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips still occur, the same shall be removed by the contractor with his own risk and cost.

**3.7.0 Backfilling**

**3.7.1 General**

The material to be used for backfilling shall be approved by the engineer which shall be obtained directly from the excavation, from the nearby areas where excavation work by the same agency is in progress, from the temporary stacks of excavated spoils or from the borrow pits as directed by the engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials etc.

In locations where sand filling is required, the sand used should be clean, well graded and be of the quality normally acceptable for use in concrete.

**3.7.2 Filling and Compaction in Pits and Trenches all Around the Structures**

As soon as the work in foundation has been accepted, the spaces around the foundation in pits and trenches shall be cleared of all debris, brick bats, mortar droppings etc and filled with approved earth in layers not exceeding 250mm (in loose thickness). Each layer(loose) shall be watered, rammed and properly compacted to the required degree to the satisfaction of the engineer. Earth shall be compacted with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the engineer. The moisture content of the fill material during compaction shall be controlled near to its optimum moisture content so as to obtain the required degree of compaction. The final surface shall be trimmed and levelled to proper profile as desired by the engineer.

**3.7.3 Plinth Filling**

The plinth shall be filled with earth in layers not exceeding 250mm (in loose thickness) and each layer shall be watered and compacted to the required degree with approved compaction machine or manually if specifically permitted by the engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted in order to avoid any settlement at a later stage. The finished surface of fill shall be trimmed to the slope intended to be provided for the floor.

### 3.7.4 Filling in Trenches for Water Pipes and Drains

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150mm, watered, rammed and compacted taking care that no damage is caused to the pipe below.

In case of trenches excavated in rock, the filling upto a height of 300mm or the diameter of the pipe whichever is more above the crown of the pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash as per the availability at site and shall be filled in compacted layers not exceeding 150mm. The remaining filling shall be done in layers with the mixture of boulders (of size not exceeding 150mm) and fine material as specified elsewhere in the specification. Each layer shall be watered, rammed and compacted to the required degree and to the satisfaction of the engineer.

### 3.7.5 Filling in Disposal Area

Surplus materials from excavation which are not required for backfilling shall be disposed of in the designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250mm thick when loose, watered and compacted with the help of a compacting equipment as per the directions of the engineer. In wide areas, rollers shall be employed and compaction shall be done to the satisfaction of the engineer at the optimum moisture content which shall be checked and controlled by the contractor. In certain cases the engineer may direct the contractor to dispose the surplus materials without compaction which can be done by tipping the spoils from a high bench neatly maintaining a proper level and grade of the bench.

### 3.8.0 Approaches and Fencing

The contractor should provide and maintain proper approaches for the workmen and inspection. The roads and approaches around the excavation should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as around the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

### 3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

## 4.0.0 TESTING AND ACCEPTANCE CRITERIA

### 4.1.0 Excavation

On completion of excavation, the dimension of the pits will be checked as per the drawings after the pits are completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations are filled back to the required lines, levels and grades by placing ordinary cement concrete of 1:4:8 proportion and/or richer and/or by compacted earth as directed by the engineer. The choice of the grade of concrete will be a matter of unfettered discretion of the engineer. Over excavation of the sides shall be made good by the contractor while carrying out the backfilling. The excavation work will be accepted after the above requirements are fulfilled and all the temporary approaches encroaching inside the excavation have been removed.

### 4.2.0 Backfilling

The degree of compaction required will be as per the stipulation laid down in IS:4701 and the actual method of measuring the degree of compaction will be as decided by the engineer. The work of back filling will be accepted after the engineer is satisfied with the degree of compaction achieved.

## 5.0.0 RATES AND MEASUREMENTS

### 5.1.0 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding section in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

f) In case blasting in hard rock is envisaged, the unit rate quoted for earth work shall include the cost of storage and safety arrangements for the materials required for blasting. No separate payment will be made on this account.

## 5.2.0 Measurements

Method of measurements are specified as below:

a) The length, breadth and depth shall be measured correct to the nearest centimeter if measurements are taken by tape. Rounding of numerical shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter respectively correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in excavation shall be computed from these levels in cubic meter.

c) In case of open footings (rafts/ pilecaps/ drains/ cable trench/ pipe trench/ sub soil beams etc.) up to the depth of 2.0 metres, alround excavation of 30 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities. (Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in item of work in the schedule of quantities).

d) In case of open footings (Rafts/ pilecaps / drains/ cable trench/ pipe trench/ sub soil beams etc.) at a depth of more than 2.0 metre, alround excavation of 75 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities. (Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in item of work in the schedule of quantities).

**e) IN TRENCHES FOR BURIED PIPES & CABLES**

**Width of Trench**

i) Upto one metre depth the authorized width of trench for excavation

shall be arrived at by adding 25 cm to the external diameter of pipe (not socket/ collar) cable, conduit etc. Where a pipe is laid on concrete bed/ cushioning layer, the authorized width shall be the external diameter of pipe (not socket/ collar) plus 25 cm or the width of concrete bed/ cushioning layer whichever is more.

ii) For depths exceeding one metre, an allowance of 5 cm per metre of depth for each side of the trench shall be added to the authorized width (that is external diameter of pipe plus 25 cm) for excavation. This allowance shall apply to the entire depth of the trench. In firm soils the sides of the trenches shall be kept vertical upto depth of 2 metres from the bottom. For depths greater than 2 metres, the excavation profiles shall be widened by allowing steps of 50 cm on either side after every two metres from bottom. Where the soil is soft, loose or slushy, width of trench shall be suitably increased or side sloped or the soil shored up as directed by the Engineer-in-Charge. However, any additional excavation beyond the limit specified for firm soil herein shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities as these are deemed to be included in item of work in the schedule of quantities.

iii) Where more than one pipe, cable, conduit etc, are laid, the diameter shall be reckoned as the horizontal distance from outside to outside of the outermost pipes, cable, conduit etc.

f) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation, then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

g) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rock so arrived shall be taken as soil.

h) The authorized quantity (calculated on the basis of authorized width/ working space under clause no. 5.2.0 c, 5.2.0 d & 5.2.0 e) or those actually excavated, whichever, are less, shall be measured for payment.

i) Tree cutting having girth more than 300mm shall be measured in number and are separately payable as deemed not covered in excavation items of work in the schedule of quantities.

j) Special dewatering of ground water by well point method and side protection work by sheet piling are separately payable as deemed not covered in excavation items of work in the schedule of quantities.

## 6.0.0 INFORMATION TO BE SUBMITTED BY THE BIDDER

### 6.1.0 With Tender

Detail of equipments and machineries proposed to be used for excavation, back-filling and compaction shall be submitted along with the tender.

### 6.2.0 After Award

After award of the contract the successful bidder shall submit the following for approval.

a) Within 30 days of the award of contract, the contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation for the various foundations and the time required for backfilling and compaction after completion of foundation for the structures. The earthwork programme shall be planned in accordance with the foundation programme. The programme should also show how the excavation and backfilling quantities will be balanced minimizing the temporary stacking of spoils. It is to be noted that the engineer even after initial approval of the programme may instruct the contractor to enhance or to retard the progress of work during the actual execution in order to match with the progress of foundations. The initial programme being submitted by the contractor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of the award of contract, the contractor shall submit the drawings for earth work in excavation and backfilling showing detail of slopes, shoring, approaches, sump pits, dewatering lines, fencing etc for the approval of the engineer.

| | | |
|---|---|---|
| Maharatna Company | **TITLE:**<br>**TECHNICAL SPECIFICATION FOR EARTHWORK IN EXCAVATION AND BACKFILLING** | SPECIFICATION NO. PE-TS-999-600-C001<br>VOLUME - II B<br>SECTION - D \| SUB-SECTION – D1<br>REV.NO. 00 DATE 21/09/2017<br>SHEET 23 OF 23 |

# VOLUME – II B
## CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

## SPECIFICATION NO. PE-TS-999-600-C002

## SECTION – D

## SUB SECTION – D2

## *GENERAL TECHNICAL SPECIFICATION*

## CEMENT CONCRETE (PLAIN & REINFORCED)

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

# C 0 N T E N T

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# SUB-SECTION – D2

## CEMENT CONCRETE (PLAIN & REINFORCED)

**1.00.00 SCOPE**

**1.01.00 General**

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. Special requirements for structures such as reinforced concrete chimney, cooling towers, etc. have been covered under the respective specifications. Those specifications shall be used in conjunction with this specification.

**1.02.00** IS: 456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate Code, specifications and/or replacement by any International code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference. However, should the list be not exhaustive and does not cover any aspect of the work, then relevant Indian and, in its absence, relevant International code shall apply.

**2.00.00 General**

**2.01.00 Work to be provided for by the Contractor**

The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following

a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.

b) Prepare Bar bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.

c) Prepare working drawings of formworks, scaffolds, supports, etc.

d) Prepare shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.

e) Prepare detailed drawings of supports, templates, hangers, etc. required for

installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

As decided by the Engineer some or all of the drawings & schedules prepared under item (b) to (e) above will have to be submitted for approval.

f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.

g) Design and submit for approval concrete mix designs required to be adopted on the job.

Furnish samples and submit for approval results of tests of various properties of the following:

i) The various ingredients of concrete

ii) Concrete

iii) Embedments

iv) Joint seals

i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.

j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

**2.02.00 Work by others**

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

**2.03.00 Information to be submitted by the Tenderer**

**2.03.01 With Tender**

The following technical information's are required with the tender:

a) Source and arrangement of processing of aggregates proposed to be adopted.

b) Type of plant and equipment proposed to be used.

c) Names of firms with which association is sought for to execute the special items of work in the contract.

d) Types of formwork proposed to be used.

**2.03.02 After Award**

The Contractor shall submit the following information and data including samples where necessary, progressively during the execution of the contract.

a) Programme of Execution

Within 30 days of the award of contract, the Contractor will submit a Master Programme for completion of the work.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day Programme of every month is to be submitted by the Contractor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. The Engineer for future reference will preserve approved samples. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities:

i) Coarse and fine aggregates.

ii) Admixtures.

iii) Plywood for Formwork.

iv) Embedded and anchorage materials as may be desired by the Engineer.

v) Joint sealing strips and other*waterproofing materials.

vi) Joint filling compounds.

vii) Foundation quality Rubber Pads.

c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant I.S., is to be submitted to the Engineer for his approval before it can be used on the works.

d) Bar Bending Schedules

Bar Sending Schedules in accordance with Clause 2.01.00 (b) and 3.16.01 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.01.00 (c).

f) Detailed Drawings for Templates & Temporary Supports for embedment As per Clause 2.01.00 (e).

g) Mill Test Reports for Cement & Reinforcing Steel.

h) Inspection Reports

The Engineer in accordance with Clause 2.04.00 of this specification may desire inspection Reports in respect of Formwork and Reinforcement and any other item of work as.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0: SAMPLING & TESTING of this specification or as directed by the Engineer.

j) Any other data, which may be required as per this specification or as directed by the Engineer.

**2.04.00 Conformity with Design**

The Contractor will prepare checklists in approved Performa, which will be called "Pour Cards". These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the engineer will give written permission on the same Pour

Cards allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

**2.05.00 Materials to be used**

**2.05.01 General Requirement**

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless-stated otherwise and be of best approved quality.

**2.05.02 Cement**

Ordinary Portland cement of grade-43 as per IS:8112/fly ash based Portland puzzolona cement conforming to IS:1489 (Part-1) shall preferably be used in reinforced/plain cement concrete works for all areas other than for the critical structures identified below. However, other types of cement such as ordinary Portland cement conforming to IS:269, Portland slag cement conforming to IS:455 respectively can be used under special circumstances. Cement used in all concrete mixes shall be in general of grade 33/43 unless design requires a higher grade. Ordinary Portland cement shall be used for following structure.

a) TG foundation top deck and sub structures including raft.

b) Spring Supporting decks of all machine foundations.

c) Structures requiring grade of concrete of M30 and above.

In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Ordinary Portland Cement etc. may be permitted or directed to be used by the Engineer.
For Brickwork, plaster, flooring and other finishing works, ordinary Portland cement of 33/43 grade shall be used.

**2.05.03 Coarse Aggregate**

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as

Coarse Aggregate. Coarse aggregate for concrete shall be chemically inert, hard, strong durable against weathering, of limited porosity, and free from deleterious materials. It shall be properly graded. Coarse aggregates shall be either crushed gravel or stone. All aggregates shall meet the requirement of IS:383:1970. Only Coarse Aggregate from, approved quarries and conforming to IS-383 will be allowed to be used on the works. Petrographic test shall be carried out by the contractor free of cost for checking the quality of rock from quarry. This test shall be repeated by the Contractor free of cost for change in quarry or as directed by the Engineer. The results shall be checked for reactivity of silica in aggregate with alkalis of cement.

**2.05.04 Fine Aggregate**

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS: 383 are termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used in works. Sand shall be hard, durable, clean and free from adherent coatings or organic matter and clay balls or pellets. Sand when used as fine aggregate in concrete shall conform to IS:383. For plaster, it shall conform to IS:1542 and for masonry work to IS:2116.

**2.05.05 Water**

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts, or other impurities. Generally, IS: 3550 will be followed for routine tests. Acceptance of water shall be as per IS: 456.

**2.05.06 Admixture**

Only admixtures of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures, which may be necessary to satisfy the concrete mix and the design requirement, shall be as per IS-9103 and may be one of the followings:

a) Accelerating admixture

b) Retarding admixture

c) Water reducing admixture

d) Air entraining admixture

e) Water proofing admixture

The contractor shall inform the Engineer about the type of admixture which he is planning to use in different areas within the scope of work for the approval

of the Engineer. The admixture shall be of proven make and from a reputed manufacturer. It should not have any adverse effect on strength, durability of concrete and reinforcement. Super plasticizers conforming to IS: 9103 or ASTMC-494 shall only be used as admixture having the above properties either individually or in a combination as per the direction of the Engineer.

**2.05.07 Reinforcement**

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.

**2.06.00 Storage of Materials**

**2.06.01 General**

All materials shall be stored so as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realised from the Contractor's dues. The Contractor shall maintain upto-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.

**2.06.02 Cement**

Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventilated warehouses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

**2.06.03 Aggregates**

Aggregates shall be stored on raised surface constructed by providing planks or steel plates or on concrete or brick masonry pavement. Each size shall be kept separated with wooden or steel or concrete or masonry bulkheads or in separate stacks and sufficient care shall be taken to prevent the material at the

edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

**2.06.04 Reinforcement**

Reinforcing steel shall be stored consignment-wise and size-wise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease, and distortions.

If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

**2.07.00 Quality Control**

Contractor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same. The quality control operation shall include but not be limited to the following items of work:

| | |
|---|---|
| a) Admixture: | Type, quantity, physical, and chemical properties that affects strength, workability, and durability of concrete.<br><br>For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits. |
| b) Aggregate: | Physical, chemical and mineralogical qualities. Grading, moisture content and impurities. |
| c) Water: | Impurities tests. |
| d) Cement: | Tests to satisfy relevant IS Specifications. |
| e) Formwork: | Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating. |
| f) Reinforcement: | Shapes, dimensions, length of splices, clearances, ties and supports. Quality and requirement of welded splices. |

Material tests or Certificates to satisfy relevant IS Specification.

g) Grades of Concrete: Usage and mix design, testing of all properties.

h) Batching & Mixing: Types and capacity of plant, concrete mixers and transportation equipment.

i) Joints: Locations of joints, water stops and filler materials. Dimension of joints, quality, and shape of joint material and splices.

j) Embedded and Anchorage Items: Material, shape, location, setting.

k) Placing: Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.

l) Compaction: Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.

m) Setting of base & Bearing plates: Lines, elevations, and bedding mortar.

n) Concrete Finishes: Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.

o) Curing: Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.

## 3.00.00 INSTALLATION

All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not

cover all the aspects to the full satisfaction of the Engineer.

**3.01.00 Washing and Screening of Aggregates**

Washing and screening of coarse and fine aggregates to remove fines, dirt, or other deleterious materials shall be carried out by approved means as desired by the Engineer.

**3.02.00 Admixture**

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures including plasticisers of approved make may be used with the Engineer's approval in accordance with IS-456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or owner satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

**3.03.00 Grades of Concrete**

Concrete shall be in one of the grades designated in IS: 456. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, IS: 3370 will be followed. Minimum cement content shall be as per IS: 456.

**3.04.00 Proportioning and Works Control**

**3.04.01 General**

"Design Mix Concrete" and "Nominal Mix Design" is defined as follows for use in this specification:

a) Proportioning of ingredients of concrete made with preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete".

b) Proportioning of ingredients of concrete made without preliminary tests adopting nominal concrete mix. Such concrete shall be called "Nominal Mix Concrete".

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades M-15 or lower only may be used if shown on drawings or approved by the Engineer. In all cases the Proportioning of ingredients and works control shall be in accordance with IS: 456 and shall be

adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

**3.04.02 Mix Design Criteria**

Concrete mixes will be designed by the Contractor to achieve the strength, durability, and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations

a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.

b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.

c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.

d) The finished concrete should have adequate durability in all condition, to withstand satisfactorily the weather and other destruction agencies, which it is expected to be subjected to in actual service.

e) The mix design shall have required workability and characteristic strength as per IS: 456. The quantity of cement, aggregates, and admixtures shall be determined by mass.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete in structural design. The Contractor will strictly abide by the same in his design of concrete mix installation. Various trials shall be given by the contractor with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

**3.05.00 Strength Requirements**

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall be as per IS:456. All other relevant clauses of IS:456 shall also apply.

**3.06.00 Minimum Cement Content**

The minimum cement content for each grade of concrete shall be as per IS: 456. Contractor has to consider actual environmental exposure condition at

site. Based on various tests results and as per Engineer, the environment condition shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition.

a) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.

b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.

c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

**3.07.00 Water-Cement Ratio**

The choice of water-cement ratio in designing a concrete mix will depend on:-

a) The requirement of strength.

b) The requirement of durability.

**3.07.01 Strength Requirement**

In case of "Design Mix Concrete" the water-cement ratio of such value as to give acceptable test results as per IS: 456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified in Table-5 of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.

**3.07.02 Durability Requirement**

Tables 4 & 5 of IS: 456 give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by Durability consideration is lower than that required from strength criteria, the former should be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. Trial mix shall be carried out accordingly. However, the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer.

**3.08.00 Workability**

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend*on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below:

## TABLE-V

## LIMITS OF CONSISTENCY

| Degree of workability | Slump in mm with Standard Cone as per IS: 1199 | | Use for which concrete is suitable |
|---|---|---|---|
| | Min. | Max. | |
| Very low | 0 | 25 | Large Mass concrete structure with heavy compaction equipments, roads |
| Low | 25 | 50 | Uncongested wide and shallow R.C.C. structures |
| Medium | 50 | 100 | Deep but wide R.C.C. structures with congestion of reinforcement and inserts |
| High | 100 | 150 | Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts. |

Note: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests.

**3.09.00 Size of coarse Aggregates**

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer

Very narrow space - 12 mm

Reinforced concrete
Except foundation - 20 mm

| | |
|---|---|
| Ordinary Plain concrete and Reinforced concrete foundations | - 40 mm |
| Mass concrete | - 80 mm |
| Lean concrete | - 40 mm |

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles

80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

**3.09.01** Temperature control of concrete in top decks of machine foundations (i.e. of TGs, BFPs, Fans and Mills) as extra payable over RCC item of BOQ:

The temperature of fresh concrete shall not exceed 23°C when placed. A suitable measuring device for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of the 23°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming IS: 456. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 23°C.

**3.09.02** Base raft of Turbo Generator foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint.

**3.10.00 Mixing of Concrete**

Ingredients of the concrete mix shall be measured by weight. Concrete shall always be mixed in mechanical mixer. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case

shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent Aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Batching Plant shall conform to IS: 4925. The measuring gauges of batching plant shall be periodically calibrated for which the contractor shall provide standard weights. The accuracy of all gauges shall be within limits prescribed by the Engineer.

When hand mixing is permitted by the Engineer, for unimportant out of the way locations in small quantities, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the owner.

**3.11.00 Conveying Concrete**

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in-spite of all precautions, segregations does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers, which will reduce the rate of loss of water, by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before, commencement of concrete mixing. Such equipments shall be kept free from set concrete.

**3.12.00 Placing and Compacting Concrete**

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in relevant I.S. code for any particular aspect of work, any other standard code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:

a) Earth foundation

b) Rock foundation

c) Formwork

d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and hardened.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed or cement slurry will be spread thoroughly on the rock Foundation or construction joint just prior to

placement of concrete.

After concrete has been placed, it shall be spread, if necessary & thoroughly compacted by approved mechanical vibration to maximum, subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice: In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS: 2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green Concrete, which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

Slabs, beams, and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Mouldings, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

**3.13.00 Construction Joints and Cold Joints**

**3.13.01 Construction Joints**

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction.

Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

Where the location of the joints are not specified, it will be in accordance with the following:

a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.

b) Concrete in a beam shall preferably be placed without a joint, but if Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.

c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.

d) Feather-edges in concrete shall be avoided while forming a joint.

e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.

f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

**3.13.02 Cold Joint**

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of

placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.

b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 *mm* in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.

c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It Will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

**3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces**

**3.14.01** Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing, and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner, All concrete work shall be inspected by the Contractor immediately after the forms are removed & he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:

a) Sack rubbing with mortar and stoning with carborundum stone.

b) Cutting away the defective concrete to the required depth shape.

c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.

d) Roughening by sand blasting or chipping.

e) Installing additional reinforcement/welded mesh fabric.

f) Dry packing with stiff mortar.

g) Plastering, guniting, shotcreting etc.

h) Placing and compacting concrete in the void left by cutting out defective concrete.

i) Grouting with cement sand slurry of 1:1 mix.

j) Repairing with a suitable mortar either cement or resin modified mortars.

k) Polymer modified patching and adhesive repair& mortar for beams & columns.

**3.14.02 Finishing unformed Surface**

The contractor shall provide normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common cases of treatment of concrete surface are cited below

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done, as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes,

ripples, and trowel marks.

A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beans, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

**3.15.00 Protection and Curing of concrete**

Newly placed concrete shall be protected by approved means from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive 'Loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas, or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor. Quality of water for curing shall be as per IS: 456.

If permitted by the Engineer, liquid curing compound may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall be emulsified paraffin based and shall comply with ASTM requirements for

acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision at no extra cost.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case the Engineer notices any lapse on the part of the Contractor, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the Contractor, or deduct certain amount from contractor's payment for the part where inadequate curing was noticed entirely at the discretion of the Engineer.

**3.16.00 Reinforcement**

Mild steel round bars, TMT bars, Hot rolled deformed bars or cold twisted deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc, will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS: 9077, as shown on the drawing or as directed by the Engineer.

**3.16.01 Bar Bending Schedules**

The Contractor shall prepare Bar Bending Schedules showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, progressively, starting within one week of receipt of approval on corresponding design of RCC structure. As decided by the Engineer, some or all the detailed drawings and schedules will have to be submitted for approval. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor for record and distribution shall submit six prints of the final drawings & schedules with one reproducible print.

**3.16.02 Cleaning**

All steel for reinforcement shall be free from loose scales, oil, grease, paint or

other harmful matters immediately before placing the concrete.

**3.16.03 Bending**

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS: 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding with the final Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any cutting, bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

**3.16.04 Placing in Position**

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire or by tack welding in case of Bar larger than 25 mm dia., as may be directed by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

**3.16.05 Welding / Coupler for Splicing**

Lapping shall normally do splicing of reinforcement. For M.S. reinforcement bars, butt-welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. For High yield strength deformed bars, lap welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards as per IS: 9417.

Welding of High yield strength deformed bar shall not be allowed.

Splicing of reinforcement using mechanical coupler may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian standards for "Reinforcement couplers for mechanical splices of bars in concrete" as per IS: 16172. Corrosion test in the coupler-bar connections exposed to marine or severe environmental conditions to rule out any risk of galvanic corrosion will be done by the contractor at no extra cost. Proper fitting & fixing of mechanical coupler to rebar shall be ensured at site for each coupled joint as per inspection testing plan developed at site in consultation with manufacturer of coupler. If so required at site, coupler/ threading on rebar shall be such that two bars can be coupled by moving couplers not rebar (as being heavy reinforcement weight and L shaped, it is not feasible to rotate the rebar for fixing up the coupler) at no extra cost.

**3.16.06 Control**

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS: 456, unless otherwise specified. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position does not have to bear extra load and get disturbed. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by –volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.

**3.17.00 Cold Weather Concreting**

When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.

**3.18.00 Hot Weather Concreting**

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38°C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will have to be done by the

contractor at no extra cost.

**3.19.00 Concreting under water**

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.

**3.20.00 Form Work**

**3.20.01 General**

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned not less than 8 mm in all directions for every 5 metres span. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

**3.20.02 Cleaning and Treatment of Forms**

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

**3.20.03 Design**

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

**3.20.04 Inspection of Forms**

Casting of' Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

**3.20.05 Removal of Forms**

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in IS: 456, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

**3.20.06 Tolerance**

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer:-

For - a) Sectional dimension - ± 5 mm
b) Plumb - 1 in 1000 of height
c) Levels - ± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in .the finished concrete surface & should not be taken as tolerances for the entire structure

taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

**3.20.07 Re-use of Forms**

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

**3.20.08 Classification**

Generally, the "ordinary" class formwork shall be used unless otherwise specified.

a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.

b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.

c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

**3.21.00 Opening, Chases, Grooves, Rebates, Blockouts etc.**

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

**3.22.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and other misc. Embedded Fixtures**

The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as shown on drawings and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and

to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti- corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer.

Items to be embedded

a) Inserts, hangers, anchors, frame around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.

b) Anchor bolts and plates for machinery, equipment and for structural steel work.

c) Steel structurals to be left embedded for future extension, special connection etc.

d) Dowel bars, etc. for concrete work falling under the scope of other contractors.

e) Lugs or plugs for door and window frames occurring in concrete work.

f) Flashing and jointing in concrete work.

g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

**3.23.00 Expansion and Isolation Joints**

**3.23.01 General**

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved

laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

**3.23.02 Bitumen Board/ Expanded Polystyrene Board**

a) Bitumen Board

Bitumen impregnated fibreboard of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

**3.23.03 Joint sealing strips**

Joint sealing strips may be provided at the construction, expansion, and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for jointing, testing, protection, etc. If desired by

the Engineer, joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per relevant Indian Standards for heavy-duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

ii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS: 737 of 19000 grades or 31000 grade (Designation as per IS: 6051). A minimum lap of 50 mm length is required at the joints.

iii) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm width unless specified otherwise and shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features:

i) Plain

ii) Central bulb

iii) Dumb-bell or flattened ends

iv) Ribbed and Corrugated Wings

v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

| | | |
|---|---|---|
| Specific Gravity | : | 1.1 to 1.15 |
| Shore Hardness | : | 65A to 75A |
| Tensile Strength | : | 25 - 30 N/Sq.mm |
| Maximum Safe Continuous Temperature | : | 75°C |
| Ultimate Elongation | : | Not less than 350% |

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

| | | |
|---|---|---|
| Specific Gravity | : | 1.3 to 1.35 |
| Shore Hardness | : | 60A to SOA |
| Tensile Strength | : | 10 - 15 N/Sq.mm |

| | | |
|---|---|---|
| Maximum Safe Continuous Temperature | : | 70 Deg.C |
| Ultimate Elongation | : | Not less than 275% |

**3.23.04 Bitumen Compound**

When shown in drawing or directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

**3.23.05 Isolation Joints**

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

**3.23.06 Pad**

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

**3.24.00 Grouting under Machinery or Structural Steel Bases**

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of approved manufacture having proper strength shall be used with Engineer's approval for important machineries.

**3.25.00 Precast Concrete**

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

**3.26.00 Waterproofing of Concrete Structure**

**3.26.01 General**

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per specification. The design, material, and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the

Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

**3.26.02 Water Bar/Seal/Special Treatment of Construction Joint**

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown on the drawing. In case of water bars being used at the construction joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

**Method 1:** A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two-component epoxy resin-bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

| | | |
|---|---|---|
| Compressive strength | - | 55 to 60 N/Sq.mm |
| Flexural strength | - | 5 to 30 N/sq.mm |
| Tensile strength | - | 15 N/Sq.mm (approx.) |
| Bonding strength to concrete | - | 3 N/Sq.mm (approx.) |
| Bonding strength to steel | - | 20 N/Sq.m (approx.) |

The whole operation shall be done as per manufacturers specification. The contractor shall provide manufacturer's supervision at no extra cost to the owner.

**Method 2:** One row of threaded nozzles at regular intervals not exceeding l.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the concrete has set to seal the voids in concrete near the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 kg/sq.cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor.

### 3.26.03 Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar/plaster shall conform to IS: 2645. The admixture shall not cause decrease of strength of concrete/plaster at any stage and it shall be free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5%. The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement, but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packings. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water reducing concrete admixture shall be used to provide a waterproof concrete, For achieving high strength concrete having cement content around 400 kg/cu.m. a melamine based super plasiticizer will be preferable.

a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.

b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer’s satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the Plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

### 3.26.04 Structural waterproofing

a) Nozzles spaced as required after the concrete is completed shall be drilled

into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per manufacturers specifications shall be injected under pressure to seal all voids. Special care shall be taken at joints by providing additional nozzles. The pressure grouting shall be done on the internal surface.

b) External Treatment

Two layers of (1:4) plaster of 12 mm thick each with waterproofing compound as per manufacturer's specification shall be provided on outer surface of concrete underground structures.

**3.26.05 Protective coating on Inside Surface.**

Two coats of cement based two components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

**3.26.06 Bitumen Felt: Application for Tanking**

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt should be hessian base and/or fibre base as specified in Drawing. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor without charging any extra to the Owner.

The Contractor shall execute this work in direct collaboration with one of the well-known specialized firm approved by the Engineer.

Cleaning the surface, keeping it dry, providing, necessary corner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickwork on/against concrete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

**3.26.07 Polyethylene Films: Application in Walls or base of structures**

Waterproof treatment shall be applied as outlined and as per sequence given hereunder

i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6.

ii) apply hot bitumen 80/100 grade (IS: 73-1961) at the rate of 1.0 Kg/Sq.m minimum

iii) lay black polyethylene film 250-micron (IS: 2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat-sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat-sealing, the cellophane tape is to be removed and the joints are to be tested for leaks.

iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen,

v) Lay hot bitumen 80/100 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum.

vi) Lay 250-micron polyethylene film as second layer similar to (iii)above.

viii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.

ix) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m dusted with fine sand.

x) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6 in case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

**3.27.00 Protective Coating on Concrete Surface**

**3.27.01 On Foundation**

The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing by using rubber/bitumen emulsion protective coating of approved manufacturer.

## 4.00.00 SAMPLING AND TESTING

### 4.01.00 General

The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the teat results in triplicate within 3 (three) days after completion of the test.

### 4.02.00 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per guidelines of IS: 269. Soundness Tests may also be required to be carried out if required by the Engineer. The Contractor shall carry out the tests without any expense to BHEL. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the BHEL or the Contractor. These tests are of great importance, as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

### 4.03.00 Aggregates

The contractor shall carry out any or all the tests on aggregates as may be required by the Engineer in accordance with IS: 2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

### 4.04.00 Water

Sampling and Testing of water being used for concrete works as per IS: 3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The acceptance criteria will be as per IS: 456.

### 4.05.00 Admixture

### 4.05.01 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After that, at regular intervals

and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

**4.05.02 Other Admixtures**

Tests for establishing the various properties of any other admixtures, which may be required to be added, shall be carried out by the Contractor.

**4.06.00 Concrete**

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS: 516 and IS: 1199, the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS: 516. Sampling procedure, frequency of sampling and test specimen shall conform to IS: 456. To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with IS: 456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor at his own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

**5.00.00 ACCEPTANCE CRITERIA**

**5.01.00 Standard Deviation**

Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS: 456.

**5.02.00 Acceptance Criteria**

The strength requirements and acceptance criteria shall conform to IS: 456.

**5.03.00 Inspection and Core Tests**

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to IS: 456.

**5.04.00 Load Test**

Load tests of structural members as per IS:456 may be required by the Engineer, when the strength of test specimen results falls below the required

strength.
If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

## 6.00.00 RATES AND MEASUREMENTS

### 6.01.00 Cast-in-situ Concrete

#### 6.01.01 Rates

a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall include the cost of curing by regular wetting or by using curing compound.

b) The unit rates shall include for all working conditions including at locations under water, liquid, mud, in or under foul positions and extreme weather conditions.

c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.

d) The unit rates shall include all arrangement for maintaining stability of structure during execution.

e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.

f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity (UPV) tests or other relevant tests to ascertain grade and quality, etc. of the concrete in case the concrete quality is in doubt and contractor has to establish the quality by further tests. In case of any defects, the Contractor shall rectify the same by cement/epoxy grout at his own cost.

However, mandatory UPV test as specified in the drawings shall be carried out including arrangement of all its facilities, staging, etc. and shall be

payable to the contractor as per BOQ item.

g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.

h) The quoted rate shall include the cost of MIX design, making of all trial mixes using admixtures and mixing in concrete etc. complete.

**6.01.02 Measurements**

a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic metres to the nearest two decimals.

b) No deductions shall be made for the following:

i) Ends of dissimilar materials embedded inside for example, beams, posts, girders, rafters, purlins, trusses, corbels and steps upto 500 sqcm in cross section;

ii) Opening upto 0.1 sq.m.

iii) Volume occupied by reinforcement, sleeves, anchor bolts, and similar items.

iv) Volume occupied by pipes, conduits, sheathing, etc. not exceeding 100 sq.cm. each in cross sectional area.

c) The concrete works of different grades; below and above ground floor finished level shall be measured separately, unless otherwise specified in the schedule of items. Accordingly rates shall be applied for concrete in foundation for concrete below ground floor finished level and concrete in superstructure for concrete above ground floor finished level.

d) For temperature control measures, measurement shall be done in terms of quantity of concrete in cum. in concreting of which the ice have been used or cooling of aggregates has been done to keep the temperature of freshly laid concrete to less than $23^0$C.

**6.02.00 Reinforcement**

**6.02.01 Rates**

a) The unit rates shall include for cover block, providing binding wire, welding, separator pieces between two or more layers of reinforcement required for keeping the steel in position, etc. at all elevations.

b) No extra will be paid for transportation from stores, cleaning, straightening of steel, cutting, bending, binding with annealed wire, welding, tack welding, placing the reinforcement modification of already embedded reinforcement, if required, due to faulty fabrication or placement and other cost of tools and plants, materials, labours, return of unused steel to the store, etc.

c) However, lap welding of reinforcement steel if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made. Similarly, splicing of reinforcement bars using mechanical couplers if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made.

d) No extra shall be paid for preparing and getting approved bar bending schedules (including all revisions).

e) Generally members are straight and have straight edges. However, for bending, binding, placing of reinforcement in any curved member in length or cross section or both, no extra payment shall be made.

**6.02.02 Measurements**

a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured alongwith standard hooks, cranks, bends, authorized laps, etc. whichever is less by the sectional weights. Claims for payment for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS Section weight. Nothing extra will be payable to the Contractor on account of, difference in weight, if any, due to different methods adopted for issue and measurement.

b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tonnes.

**6.03.00 Formwork and Staging**

**6.03.01 Rates**

a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.

b) No separate payment shall be made for providing fillets, for rounding or chamfering at junctions, comers, etc.

c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.

d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.

e) Payment for curved shuttering shall be made for curved members/wall whose centerline radius in plan is less than 6m.

f) If the contact surface area in pockets is less than or equal to 0.1 sq.m. in each case, payment shall be done under item for providing formwork in pockets.

**6.03.02 Measurements**

a) Formwork for different classes (types) shall be measured separately as the actual surface in contact with the concrete and paid on area basis unless included in the rate for concrete. The unit of measurement shall be in sq.m.

b) Openings upto 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

d) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.

e) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.

e) Formwork, if required, for joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

**6.04.00 Embedded Parts**

**6.04.01 Rates**

a) The unit rate for erection of embedded steel parts, supplied by Engineer

shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.

b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.

c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts and site testing if required.

**6.04.02 Measurements**

a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.

b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.

c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.

d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.

e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.

f) The expansion fasteners shall be measured in number according to tension capacity.

g) The rails shall not be treated as embedded steel part and the track shall be measured in running metres along the centre line and paid for under separate item of work as specified in schedule of items. Other related civil items associated with the laying of track shall be measured separately and paid under respective items of works.

**6.05.00 Groutings**

**6.05.01 Rates**

Rate shall include the cost of surface preparation, admixtures, and curing.

**6.05.02 Measurements:**

a) Measurement shall be in cubic decimeters.

b) Measurement for grouting shall be by volume of the block out, pockets or bolt hole upto the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.

c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.

d) No deduction shall be made for shims, bolts, shear keys and such other embedments.

f) Pressure injection grouting with cement based grout if required as per drawing shall be applied at appropriate spacing to cover the desired surface area and measurement shall be made for the surface area grouted in sqm as per BOQ item. However in water retaining structures, the structural grouting if required to ensure water tightens shall not be payable separately as deemed to be covered in water retaining concrete item of BOQ.

**6.06.00 Joints**

**6.06.01 Rates**

The unit rate shall include all the activities described in the schedule of items.

**6.06.02 Measurements**

a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

b) Water Stops

The measurement for water stops shall be in running metres of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-joints and mitered joints.

c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished surface area in square metres for the specified thickness.

d) Vibration Damping Resilient Pads

The measurement for this item shall be in square metres for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

**6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete**

**6.07.01 Rates**

The unit rates shall include the cost of all necessary propping, shoring, underpinning scaffolding, safety measures, temporary enclosures, disposal/ stacking of serviceable/unserviceable materials, etc. for all types of work and for all grades of concrete.

In the case of dismantling/demolishing work, the cutting of reinforcement shall also be included in the rate.

In the case of chipping work, the cutting of reinforcement shall be paid separately.

If the serviceable material including reinforcement steel from dismantled structure is allowed to be used/taken out by bidder, suitable rebate shall be given by bidder.

**6.07.02 Measurements**

a) Dismantling of PCC and RCC work shall be measured in cu.m separately. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed. Specifications for deductions of voids, openings etc, shall be done on the same basis as that applied for construction work.

b) Chipping of concrete, making holes/pockets etc. shall be measured in cubic decimeters (i.e. 0.001 cu.m.).

c) Cutting of reinforcement in chipping work for making of pockets and openings shall be measured in sq. cm. of cross-sectional area.

**6.08.00 Precast Concrete**

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

**6.08.01 Rates**

a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adjacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

**6.08.02 Measurements**

The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic metres nearest to second place of decimal. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings up to 0.1 sq.m. The setting of element with cement mortar shall not be measured separately The filling of concrete cement mortar between the gaps of adjacent precast units shall be considered while computing the volume of pre-cast concrete work and shall be paid for under this item itself.

**7.00.00 LIST OF IS CODES AND STANDARDS FOR REFERENCE**

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed:-

IS: 73 - Indian Standard Specification for Paving Bitumen

IS: 216 - Indian Standard Specification for Coal Tar Pitch

IS: 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete

IS: 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement

IS: 455 - Indian Standard Specification for Slag Cement

IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete

IS: 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive

Structures

IS: 516 - Indian Standard Specification for Methods of Test for Strength of Concrete

IS: 702 - Indian Standard specification for industrial bitumen.

IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete

IS: 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing

IS: 1489 - Indian Standard Specification for Portland Pozzolona Cement

IS: 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.

IS: 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts

IS: 1786 - Indian Standard Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.

IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers.

IS: 1838 - Indian Standard Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type.

IS: 2185 - Indian Standard Specification for Hollow Cement Concrete Blocks

IS: 2210 - Indian Standard Specification for Design of Reinforced Concrete shell Structures and Folded Plates

IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII

IS: 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement

IS: 2505 - Indian Standard Specification for Concrete Vibrators, Immersion Type

IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators

IS: 2514 - Indian Standard Specification for Concrete Vibrating Tables

IS: 2571 - Code of practice for laying in-situ cement concrete floors.

IS: 2645 - Integral cement water proofing compound

IS: 2722 - Indian Standard Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket type)

IS: 2750 - Indian Standard Specification for steel scaffoldings.

IS: 2751 - Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction

IS: 2770 - Indian Standard Specification for Method of Testing Bond in Reinforced Concrete

IS: 3025 - Indian Standard specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry

IS: 3067 - Code of practice for general design details and preparatory work for damp proofing and water proofing of building.

IS: 3201 - Indian Standard Specification for Design and Construction of Precast Concrete Trusses

IS: 3370 - Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids

IS: 3414 - Code of practice for design and installation of joints in buildings.

IS: 3550 - Indian Standard Specification for Method of Test for Routine Control for Water used in Industry

IS: 3558 - Code of Practice for use of Immersion vibrators for Consolidating Concrete

IS: 3696 - Safety Code for Scaffolding and Ladders

IS: 3812 - Indian Standard Specification for Fly Ash for Use as Admixture for Concrete

IS: 4014 - Code of practice for steel tubular scaffolding.

IS: 4031 - Indian Standard Specification for Method of Tests for

Hydraulic Cement

IS: 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site

IS: 4090 - Indian Standard Specification for Design of Reinforced Concrete Arches

IS: 4634 - Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixes

IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete

IS: 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant

IS: 4926 - Indian Standard Specification for Ready Mixed Concrete

IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work

IS: 4991 - Indian Standard Specification for Blast Resistant Design of structure for Explosion above ground

IS: 4995 - Indian Standard Specification for Design of Reinforced Part-I & II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials

IS: 4998 - Indian Standard Specification for Design of Reinforced Concrete Chimneys.

IS: 5256 - Code of practice for sealing joints in concrete lining on canals.

IS: 5512 - Indian Standard Specification for Flow Table for use in Tests of Cement and Pozzolanic materials

IS: 5513 - Indian Standard Specification for vacate Apparatus.

IS: 5515 - Indian Standard Specification for Compaction Factor Apparatus.

IS: 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.

IS: 5624 - Indian Standard Specification for foundation bolts.

IS: 5751 - Indian Standard Specification for Precast Concrete Coping

Blocks.

IS: 5816 - Indian Standard Specification for Method of Test for Splitting Tensile strength of Concrete Cylinders.

IS: 5891 - Indian Standard Specification for Hand operated Concrete Mixers.

IS: 5892 - Indian Standard Specification for transit mixer and agitators.

IS: 6452 - Indian Standard Specification for High Alumina Cement for Structural Use

IS: 6909 - Indian Standard Specification for Super sulphated Cement

IS: 6923 - Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.

IS: 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.

IS: 7242 - Indian Standard Specification for Concrete Spreaders.

IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete.

IS: 7251 - Indian Standard Specification for Concrete Finishers.

IS: 7293 - Safety code for working with construction machinery.

IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus.

IS: 7861 - Indian Standard Specification for Recommended Practice Part-I&II for Extreme Weather Concreting.

IS: 7969 - Safety Code for Storage and Handling of Building Materials.

IS: 8041 - Indian Standard Specification for Rapid Hardening Portland cement.

IS: 8112 - Indian Standard Specification for high strength Ordinary Portland Cement.

IS: 8142 - Indian Standard Specification for Determining Setting time of concrete by Penetration Resistance.

IS: 8989 - Safety Code for Erection of Concrete Framed Structures.

IS: 9012 - Recommended method for shortcreting.

IS: 9013 - Indian Standard Specification for Method of Making, Curing, and determining compressive Strength of Accelerated-cured Concrete Test Specimens.

IS: 9077 - Code of Practice for Corrosion Protection of Steel Reinforcement in RB and RCC Construction.

IS: 9103 - Indian Standard Specification for Admixtures for Concrete.

IS: 10262 - Recommended Guidelines for Concrete Mix Design.

IS: 13311 - Non-destructive testing of concrete.

SP: 34 - Handbook of concrete, reinforcement and detailing.

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| Maharatna Company | **TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY** | SPECIFICATION NO. PE-TS-999-600-C003<br>VOLUME - II B<br>SECTION - D SUB SECTION - D3<br>REV.NO. 0 DATE : 30/11/2015<br>SHEET 1 OF 7 |

# VOLUME: II B

## SECTION - D

## SUB-SECTION – D3

# CARPENTRY AND JOINERY

## SPECIFICATION NO. PE-TS-999-600-C003

Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

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|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY** | SPECIFICATION NO. PE-TS-999-600-C003<br>VOLUME - II B<br>SECTION - D SUB SECTION - D3<br>REV.NO. 0 DATE : 30/11/2015<br>SHEET 2 OF 7 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
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| 1.00.00 | SCOPE | 3 |
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| 4.00.00 | I.S. CODES | 6 |
| 5.00.00 | RATES AND MEASUREMENTS | 6 |

# CARPENTRY AND JOINERY

## 1.00.00 SCOPE

This section covers supply, fitting and fixing of timber frames to doors and windows with M S holdfasts, flush doors, windows, shutters, partitions, wall panelling, pelmets, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for. This shall also include the supply and fixing of all hardware and fixtures shown in drawing or specified.

## 2.00.00 INSTALLATION

### 2.00.01 Materials

a) Timber

Unless otherwise specified, all timber shall be best quality well seasoned CP teakwood free from large or loose knots, cracks or any other defects. All timber shall be treated with approved wood preservative before use, unless specified otherwise. The rough timber shall be approved by the Engineer before incorporating in the works and starting the carpenter's work.

b) Plywood

Plywood shall be of commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol formaldehyde synthetic resin of BWP grade conforming to IS: 848.

c) Decorative Laminated Plastic Sheets

The colour, pattern, finish and texture shall be approved by the Engineer. The bulk supply shall be procured in full sheet sizes which will ensure the least number or joints in one surface.

d) Flush Doors

Flush doors shall be solid core doors with commercial or decorative faces and hardwood edges conforming to IS: 2202 (Part-1). The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test certificates shall be submitted for the approval of the Engineer. The Contractor shall give a guarantee that the adhesive used is BWP grade phenol formaldehyde synthetic resin conforming to IS: 848. The thickness shall be as specified.

e) Panel Doors

Panel door shall be of teakwood shutter frame, unless otherwise noted and panels with teakwood/commercial ply/teakwood particle board. Other considerations shall be as mentioned in item (d) above.

f) Windows, Ventilators

Windows and ventilators shall made of teakwood shutter frame, unless specified otherwise and glazing of specified thickness shall be fixed with wooden beadings.

g) Fixtures

Fixtures for doors, windows, furniture etc. shall be as shown on drawing or specified.

**2.02.00 Workmanship**

**2.02.01 General**

The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.

Framing timber and other work shall be close - fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc., which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood, which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blackboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.

Fixing to frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M S holdfasts bifurcated at end and grouted with 1:2:4 cement concrete. The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M.S. grills or guard bars shall be provided to windows where called for in the drawings.

**2.02.02 Finish**

All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those, which shall be subsequently polished or covered with laminated plastic sheet.

**2.02.03 Surface Treatment**

When shown on drawings or called for, decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.

**3.00.00 ACCEPTANCE CRITERIA**

**3.00.01 Door and Window Frames**

All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane. All external door and window frames shall be caulked with mastic.

**3.02.00 Door and Window Shutters**

All doors and window shutters shall be of proper size, shape, and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.

**3.03.00 Partitions, Paneling, Pelmets, Furniture, etc.**

**3.03.01 General**

These shall conform to drawings in all details. No unsightly nail marks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

**3.03.02 Partition**

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.

**3.03.03 Pelmets**

Shall be checked for rigidity of fixing and adequate clearance of fixture.

**3.03.04 Cupboard Shutters**

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

**3.03.05 Drawers**

Shall operate smoothly and have backstops to prevent them from being pushed too far. Locks shall engage securely.

**3.03.06 Loose Furniture**

When placed on a level surface, tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.

**4.00.00 IS CODES**

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 848 - Synthetic resin adhesives for plywood (Phenolic and Aminoplastic)

IS: 1003 - Timber panelled and glazed shutters.

IS: 2191 - Wooden flush door shutter (Cellular and hollow core type).

IS: 2202 - Wooden flush door shutters (solid core type).

IS: 4021 - Timber door, window, and ventilator frames.

**5.00.00 RATES AND MEASUREMENT**

**5.01.00 Rates**

Rates shall include of all activities mentioned in “Schedule of Item” for completion of the work. No separate payment shall be made for fixing, caulking, application of primer coat, polishing, providing of butt hinges,

holdfasts, sliding/tower bolts, door stoppers, door closers and other fittings and fixtures.

**5.02.00 Measurement**

Measurement shall be done in Sqm for doors, windows, ventilators, shutters, partitions etc.

Measurement for wooden frame shall be in CuM.

Pelmets shall be measured in RM.

| | TECHNICAL SPECIFICATION FOR ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS | SPECIFICATION NO. PE-TS-999-600-C004 |
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# VOLUME: II B

## SECTION – D

### SUB-SECTION – D4

# ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS

## SPECIFICATION NO. PE-TS-999-600-C004

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | | |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS** | SPECIFICATION NO. PE-TS-999-600-C004<br>VOLUME - II B<br>SECTION - D SUB SECTION - D4<br>REV.NO. 0 DATE: 03/10/2017<br>SHEET 2 OF 15 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
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| 1.00.00 | SCOPE | 3 |
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| 5.00.00 | RATES AND MEASUREMENTS | 15 |

# ROOF AND UNDERGROUND WATER PROOFING, INSULATION AND ALLIED WORKS

## 1.00.00 SCOPE

This section covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof and underground water-proofing, insulation and allied works for buildings and at locations covered under the scope of this package.

## 2.00.00 INSTALLATION

### 2.01.00 GRADING UNDERBED

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.

The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.

The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

### 2.01.01 Cement Mortar Underbed

The underbed grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

### 2.01.02 Cement Concrete Underbed

The underbed cement concrete shall be used where the subgrade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 nominal mix

by volume with 12 mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

## 2.02.00 INSULATION

The Tenderer shall, along with the tender, send specifications of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the contractor shall send samples of insulating material to the Engineer, and after approval of the samples, the Contractor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Contractor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation, the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12 mm and it shall be cured for seven days.

### 2.02.01 Foam Concrete

This shall be of lightweight foam concrete of average 50 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl/sq.m. hr degree C. Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to withstand the usual workload and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer.

### 2.02.02 Expended Polystyrene Blocks

The expanded polystyrene block Insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 Kcl m/sq.m h °C. It must be strong enough to withstand without any deformation under the workload and standard loads expected on the roof.

The Contractor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be used for this work. If the Engineer is not satisfied about the efficiency of the workers the Contractor shall secure manufacturers supervision at no extra cost to the Owner.

**2.03.00 Fillets**

Fillets at Junction of roofs and vertical walls shall be provided with the same insulating material as provided for the main roof insulation. The fillets shall be 150 mm x 150 mm in size unless otherwise shown on drawings or instructed by the Engineer.

Where there is no insulation over roof slab, fillets shall be cast-in-situ cement concrete (1:2:4) nominal mix volume.

**2.04.00 Waterproofing Treatment**

**2.04.01 Bitumen Felt Treatment**

Waterproofing treatment shall be laid by a specialist firm with long experience in the particular trade.

The waterproofing treatment for roofs with bitumen felts shall be done following relevant IS: 1346. Bitumen felt shall conform to IS: 1322 and Bitumen primer to IS: 3384.

The bonding materials shall consist of blown type conforming to IS: 702 or residual bitumen conforming to IS: 73 or a mixture of the two to withstand local conditions of prevailing temperature or gradient of roof surface. The Contractor shall convince the Engineer that the bonding material proposed to be used is suitable for the particular job.

The Contractor shall state the source from where he proposed to procure the materials. Samples of the self-finished felt shall be submitted in advance to the Engineer along with test certificates for his review. Test certificates for the bonding materials shall also be submitted and samples, if desired by the Engineer, shall be provided for confirmatory tests. Samples shall be submitted if instructed by the Engineer.

Minimum overlaps of 100 and 75 mm shall be given at the end and sides of strips of felt and properly bonded with bitumen. Joints in successive layers of felt shall be staggered.

Normal treatment with one layer of felt, heavy treatment with two layers of felt or Extra Heavy treatment with three layers of felt shall be indicated. Brief details of the various treatments shall be as follows:

a) Normal Treatment - Five courses

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)

5) 20 mm thick pressed precast concrete tiles with 15 mm, thick 1:4 cement-sand mortar underbed.

b) Heavy Treatment - Seven Courses

With Hessian base felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

5) Hessian base self-finished felt, type 3, grade I.

6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With fibre base felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Not applied bitumen at the rate of 1.2 kg/sq.m (Min.)

3) Fibre base self-finished felt, type 2, grade 2.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

5) Fibre base self-finished felt, type 2, grade 2.

6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

c) Extra Heavy Treatment – Nine courses

With fibre based felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Fibre-base self-finished felt type 2, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (min.)

5) Fibre base self-finished felt type 2, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

7) Fibre base self-finished felt type 2, grade 1.

8) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

9) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With Hessian base felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

5) Hessian base self-finished felt, type 3, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. min.

7) Hessian base self-finished felt, type 3, grade 1.

8) Hot applied bitumen at the rate of 1.2 kg/sqm. min.

9) 20 mm thick pressed precast concrete tiles with 15 thick 1:4 cement: sand mortar underbed.

However, in special cases, more courses, or a combination of fibre base and hessian base felts may be asked for.

The surface to receive the waterproofing treatment must be cleaned and dried satisfactorily and the Engineer's approval taken before starting the work. If any existing waterproofing treatment is being augmented the existing top course shall be completely removed and all damaged felts or other defects repaired.

The Engineer may instruct the Contractor to lay part of the stipulated courses at the first instant to be followed later on with the balance courses. This interim finish shall be done with a course of hot applied bitumen. While doing the balance again hot bitumen shall be applied to start with after repair of all damages to the already laid course.

After completion the surface shall be cleaned taking care that felt cuttings etc. do not find their way into rainwater down comers.

**2.04.02 Elastomeric Membrane**

**a) Material**

The material shall consist of high solid content Polyurethane based cold liquid applied coatings as per ASTMC 836-89a comprising of urethane pre-polymers extended with flexible material, which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic or any other equivalent material permitted as per ASTM and approved by the Engineer. The material shall consist of high solid coating designed to give a high-build film. The material shall not be diluted. The coating shall have physical feature like high viscosity, 90% solids, high resistance to impact, abrasion and cracking, superior tensile strength, application limit of $70^0$C minimum, 300%

elongation and forming a perfectly smooth permanently flexible seamless membrane which should have good adhesion to roof substrates (RCC, tiles, brick, and metals), having a minimum life of 10 years. It should also be resistant to acid (mild concentrated), alkali and have a very low water absorption rate (0.5%) max. at ambient temp. after 7 days.

The pack shall not be older than 9 months after the date of manufacture and packing.

**b) Primer coat**

It shall consist of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat of an application rate of minimum 6 sq.m per litre.

The primer shall be allowed to dry for minimum of 2hrs. time before the successive finishing coats of P.U. liquid membrane is applied.

**c) Finishing coats:**

The finishing coats shall consist of two successive liquid coatings of high solids content urethane pre-polymers or equivalent material to form an elastomeric membrane. The overall dry film thickness shall be 1.5mm subject to minimum 500 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for a minimum of 150mm over the finished roof surface. It shall be continued into rain water pipes by atleast 100mm.

The final coat of P.U. liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a later of polyscrim cloth /fabric to be embedded between 2 finishing coats.

**d) Surface Finish:**

Areas of roof treatment which are vulnerable to accidental damage shall be provided with wearing course consist of minimum 20 mm thick PCC of Grade M15 (using12.5mm size aggregate) cast in panel of maximum size of 1.20m x 1.20m and reinforced with 0.56mm diameter galvanised chicken wire mesh

and sealing of joints using sealant or elastomeric compound.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided in place of stone grit and cement painted. The tiles shall be laid as per IS:1443.

**2.04.03 Waterproofing by Epoxy Resin Based Application**

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin-based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration fire, sun exposure, and light duty traffic. The application shall be resistant to growth of fungus and proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterproofness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing free the materials and labour for the application as free of cost to Owner. This item shall carry a guarantee as specified.

**2.04.02 Flashing**

Unless otherwise stated flashing shall be done in the same way as the waterproofing except that the last layer shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified or directed by the Engineer, metal flashing shall be provided. The materials shall be 18 Gage or 22 G G.I. sheets, as specified or as directed by the Engineer.

**2.05.00 WATER-PROOFING OF UNDERGROUND STRUCTURES**

Basements, ducts, pits, tunnels (excluding tanks) etc below the ground water table and in contact with soil are covered under this. Bonding material shall be blown bitumen of 65/25 grade conforming to IS: 702.

Waterproofing shall be provided on the outside of walls and top of RCC slab and shall be carried out upto 150mm above ground level. The number of layers of bitumen felt to be used for walls and floor unless otherwise shown in the drawing shall be:

a) 2 layers - for depths up to 5m below ground level

b) 3 layers - for depths beyond 5m below ground level

**2.05.01** Method of laying the bitumen felts and workmanship shall be as per IS: 1609 and IS: 3067. Water proofing work shall be taken in hand only when the sub-soil water level is at its lowest; the site shall be kept dry by adequate arrangements for pumping out water till the work has been completed.

For this purpose, drains shall be formed along the edges of the excavation but beyond the building line, with suitable collecting sumps.

In case of large excavation areas where it is necessary to dewater under the floor, additional land drains shall be formed across the excavation, to adequately drain the area.

Adequate arrangement shall be made to protect the sides of excavation from slipping while the work is in progress.

The base concrete or mud-mat shall be rendered smooth by a 20mm thick sand-cement plaster (6:1). Any sharp edges/corners, over which the waterproofing course is to be laid, shall be eased out by means of cement.

The surface must be dry before the next operation is carried out.

Water proofing/damp proofing treatment:

A) Heavy Treatment (Two layers of felt)

i) Primer (For vertical faces only), as per I.S. 3384.

ii) Hot applied blown bitumen at the rate of 1.2 Kg/m2

iii) Hessian base, bitumen felt type 3 grades 2

iv) Hot applied blown bitumen @ 1.2 Kg/m2

v) Hessian base, bitumen felt type 3 grade 2

vi) Hot applied blown bitumen @ 1.2 Kg/m2

B) Extra Heavy treatment (Three layers of felt)

i) Primer (for vertical faces only) as per I.S. 3384

ii) Hot applied bitumen at the rate of 1.2 Kg/m2

iii) Hessian base bitumen felt type 3 grades 2

iv) Hot applied bitumen at the rate 1.2 Kg/m2

v) Hessian base bitumen felt type 3 grades 2

vi) Hot applied bitumen at the rate of 1.2 Kg/m2

vii) Hessian base bitumen felt type 3 grades 2

viii) Hot applied bitumen at the rate of 1.2 Kg/m2

The surface must be dry before the next operation is carried out at each stage said above.

The laying of felt over the bitumen so applied that it shall always commence on the floor, and shall be carried over to the walls only after treatment of the floor is complete. The minimum over lapping at sides and ends of strips shall be 10cm. Point for subsequent layers completely sealed by blow lamp.

A protective flooring of either brick flat in cement mortar (1:3) or 6cm thick cement concrete (M 15) or a coat of cement plaster (1:3) 4 cm thick shall be constructed over the bitumen layers to prevent damage to the latter during subsequent construction of the structural floor.

The walls shall be treated in a similar way; the bitumen felts joining at the base with the projecting felt laid over the mud-mat. The wall surface shall be made smooth where necessary with a coat of cement plaster (1:3), the felts laid as for the floor, ensuring that the surface to be treated is dry and then a protective brick wall, 12.5 cm nominal thickness shall be built in cement mortar (1:3) over the projecting mud-mat, the space between the wall and felt being grouted with cement.

## 3.00.00 ACCEPTANCE CRITERIA AND GUARANTEE

The surface level shall be such as to allow quick draining of rains without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

The contractor shall give a guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof waterproofing treatment work. The guarantee shall be for materials and workmanship as under:

For Bitumen Felt Treatment under clause no. 2.04.01: 5 years in case of normal treatment, 10 years for heavy treatment and 20 years for extra heavy treatment.

For Elastomeric Membrane under clause no. 2.04.02: 10 (ten) years.

In case guarantee is more stringent in owner specification, more stringent guarantee shall be applicable. The mode of execution of the guarantee shall be such, which shall be acceptable to the Owner.

## 4.00.00 I.S. CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

| | | | |
|---|---|---|---|
| a) | IS: 73 | - | Paving Bitumen |
| b) | IS: 702 | - | Industrial Bitumen |
| c) | IS: 1203 | - | Methods of testing tar and bitumen |
| d) | IS: 1322 | - | Bitumen felts for waterproofing and damp proofing. |
| e) | IS: 1346 | - | Code of practice for waterproofing of roofs with bitumen felts. |
| f) | IS: 1609 | - | Damp-proofing Treatment using Bitumen Felts – Code of Practice |
| g) | IS: 3067 | - | Code of practice for General design details and preparatory work for Damp-proofing and water-proofing of buildings |
| h) | IS: 3384 | - | Bitumen primer for use in waterproofing and damp proofing. |

## 5.00.00 RATES AND MEASUREMENT

### 5.01.00 Rates

Rates shall be for complete work, including the cost of all materials and labor, as detailed in the specification unless any portion is specifically excluded in the "Schedule of Items".

No extra shall be paid for finishing around opening, sleeves, pipes, ducts, inserts, etc.

No separate payments shall be made for cleaning of surface, treating of cracks and surface preparation.

### 5.02.00 Measurement

The finished work shall be measured in Sqm of actual surface area for the purpose of payment.

No deduction shall be made and no extra shall be paid for openings upto 0.4 sqm.

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C005 |
|---|---|---|
| | **TECHNICAL SPECIFICATION FOR METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.** | VOLUME - II B |
| | | SECTION - D \| SUB-SECTION – D5 |
| | | REV.NO. 00 DATE 03/10/2017 |
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# VOLUME: II B

## SECTION - D

### SUB-SECTION – D5

## METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

## SPECIFICATION NO. PE-TS-999-600-C005

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C005 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D5<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 2 OF 15 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | SCOPE | 3 |
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| 4.00.00 | INFORMATION TO BE SUBMITTED | 9 |
| 5.00.00 | I.S. CODES | 10 |
| 6.00.00 | RATES AND MEASUREMENTS | 10 |

**ATTACHMENT**

| | | |
|---|---|---|
| ANNEXURE – A | SCHEDULE OF FIXTURES | 12 |

# METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

## 1.00.00 SCOPE

This section covers supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. The scope of work shall also include the assembly and erection of all doors, windows, louvers, glazed partitions, etc. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

## 2.00.00 INSTALLATION

### 2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS:733 or IS:1285 or as manufactured by Indian Aluminium Company Limited or approved equivalent. Aluminium door, windows and ventilator shall be fabricated as per IS:1948 and IS:1949. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified and the best quality from approved manufacturers shall only be used. The tenderer shall specifically state the particular manufacturer's materials he proposes to use. Improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or shall be replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance Requirements and endurance test stated in IS: 3564 - Appendix-A. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards end for incorporation in the job. The mastic for caulking shall be of best quality from a manufacturer approved by, the Engineer. In general, mastic for fixing of metals frames shall be as per IS: 1081 or as approved by the Engineer.

## 2.02.00 Fabrication

### 2.02.01 Steel Doors, Windows, Ventilators, louvers etc.

a) Door Frames

Frames shall be fabricated from 16 gage(G) sheets. They shall, be mortised, reinforced, drilled, and tapped for hinge lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered Corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be installed. Frames shall be brought to site with floor ties/weather bars installed in, place.

b) Double Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of the outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres.

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting-stile edges bevelled or rebated. Where shown on drawing, or called for in the schedule of items, the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled, and tapped in shop for hinges, locks, and bolts. They shall also be reinforced for closers, push-plates, and other surface hardware's where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 16 G sheets.

c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) “Double Plate Flush Door Shutters.”

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18-gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361 latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Jindal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.

**2.02.02 Aluminium Door, Windows, and Frames**

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 15-micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

**2.03.00 Shop Coat or Paint**

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

**2.04.00 Handling & Storage of Fabricated Material**

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

**2.05.00 Assembly & Erection at Site**

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places, keening proper “Lines and levels”, and in approved workmanlike manner, to give trouble free and leak-proof installations. Installation shall be done according to instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take all precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the cement in original sealed containers of manufacturer and shall apply it as per the instruction. For all frames supplied by either the owner or the Contractor, mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one meters from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

**2.06.0 Fire proof Door**

Fire proof doors shall be provided at all fire exit points as specified and also to restrict the spread of fire within buildings whether from internal fire or from external fire. The construction details of door shall conform to the requirements stipulated in IS:3614 (Part-1). Doors shall comply with the testing requirement mentioned in IS:3614 (Part-2). The doors shall be approved by Tariff Advisory Committee and shall have minimum 2 hrs. fire rating.

Metal covered (on both sides) Doors having insulating core filled up with mineral wool shall be used at all fire exit points and shall open outside.

All necessary accessories and hardware shall also be supplied along with doors. Fire proof door shall be provided with zinc silicate primer (minimum DFT 75 micron) after blast cleaning the surface to near white metal surface and shall be finished painted with epoxy based painting.

**3.00.00 ACCEPTANCE CRITERIA**

**3.01.00 For fabricated Items**

a) Overall dimensions shall be within ±1.5 mm of the size shown on drawings.

b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ±1.5 mm from the axis of the member.

c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm for double leaf doors; the gap at the meeting stiles shall not be more than 1.5 mm.

d) Door leaves shall be undercut where shown on drawings.

e) Doors, windows, frames, etc. shall be on a true plane, free from warp or buckle.

f) All welds shall be dressed flush on exposed and contact surfaces.

g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures

h) Provision for hardware and fixtures to be installed at site.

i) Glazing beads shall be cut with mitered corners.

j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.

k) Shop coats shall be properly applied.

l) Exposed aluminum surfaces shall be free from scratches, stains, and discoloration. Anodized surfaces shall present a uniform and pleasing look.

**3.02.00 For installed Items**

a) Installations shall be at correct location, elevation and in general, on a true vertical plane.

b) Fixing details shall be strictly as shown on drawings.

c) Assembly of composite units shall be strictly, as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.

d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.

e) All openable section shall operate smoothly without jamming.

f) Locks, fasteners etc. shall be engage positively. Key shall, be non-interchangeable.

g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.

h) Aluminium doors, windows, etc. shall be free from scratches stain or discoloration.

**4.00.00 INFORMATION TO BE SUBMITTED**

**4.01.00 With Tender**

a) Names of manufacturers for Doors, windows etc.

b) Manufacturer's catalogue for all hardware and fixtures proposed to be used.

**4.02.00 After Award**

a) Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.

b) He shall submit a programme of work to be done for the approval of the Engineer.

c) Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall by retained by the Engineer for comparison of bulk supply and returned to the Contractor towards the end for final incorporation in the job.

## 5.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

| | | |
|---|---|---|
| Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose) | - | IS: 733 |
| Specification for Wrought Aluminium and Aluminium Alloy, extruded round tube, hollow section (for general engineering purpose) | - | IS: 1285 |
| Steel doors, windows, and ventilators | - | IS: 1038 |
| Steel windows for industrial, building | - | IS: 1361 |
| Aluminium doors windows, and ventilators | - | IS: 1948 |
| Aluminium windows for industrial buildings | - | IS: 1949 |
| Steel doorframes | - | IS: 4351 |
| Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows and Ventilators. | - | IS: 1081 |
| Specification for Fire-check Doors – Part 1: Plate, Metal covered and Rolling type | - | IS: 3614 |
| Hot Rolled Steel Sections for Doors, Windows and Ventilators – Specification | - | IS: 7452 |

## 6.00.00 RATES AND MEASUREMENT

### 6.01.00 Rates

Rates shall be applicable of all elevation. Rates shall include preparation of working drawings (if required), supply of material, fixtures, gaskets, erection of unit, caulking and jamming of frames, including cutting/drilling/welding, grouting, grinding, making good of the structure for installing the unit etc. complete as per “Schedule of Items”.

Rates shall also include cost of surface preparation, application of primer, enamel painting or anodizing as applicable.

Rate for fire proof door is inclusive of providing insulation core, primer, shop painting (epoxy based), all hardware as specified in Schedule of items.

### 6.02.00 Measurement

Supply and installation of doors, windows, and ventilators shall be measured in Sqm or Kg as per BOQ item. If measured in sqm, it shall be for net outer to outer (excluding frame) area of doors, windows, and ventilators of each type used as described in “Schedule of Items”. Frame for steel or aluminum shall be measured in Kgs. Wooden frames shall be measured in Cum. Measurement for aluminum partition frames shall be in Kg. Paneling and glazing shall be paid separately if not covered in BOQ item description.

Measurement for fire proof door shall be in Sqm in net area outer to outer of the door.

ANNEXURE-A

## SCHEDULE OF FIXTURES

### A. TIMBER DOORS

1. For single leaf panel/flush doors

   i) 100 mm brass butt hinges with screws - 3 Nos.

   ii) 150 mm brass tower bolts with screws - 1 No.

   iii) 100 mm x 225 mm clear plastic push Plate with counter sunk brass screws - 1 No.

   iv) 30 mm brass ring pull handle with Plates and screws - 1 No.

   v) 150 mm brass coat hook with screws - 1 No.

   vi) Heavy duty, cylinder looks on active leaf - for flush door. For door-closure, see "Door Schedule".

### B. ALUMINIUM DOORS

1. For double leaf door

   i) Concealed hanging arrangement for door leaves.

   ii) Concealed two points bolt encasing simultaneously at head and threshold on inactive leaf, operable from inside.

   iii) Heavy duty, cylinder look on active leaf.

   iv) Pull handle of approved design on both leaves.

   v) Doors stops for both leaves.

   vi) Overhead door closure for both leaves.

ANNEXURE-A

## C. STEEL DOORS AND WINDOWS

### 1. Doors

a) Double leaf doors

i) 100 mm butt hinges - 3 Nos. on each leaf.

ii) 300 mm aluminum tower bolt - 2 Nos. (top and bottom) On inside of inactive Leaf. 1. No. (Top only) On inside active leaf.

iii) 200 mm anodized aluminum pull handle - 1 No. of each leaf.

iv) Door stop of approved design - 1 No. of each leaf.

NOTE: For locks, door closure and threshold, see "Door Schedule".

b) Single leaf doors

i) 100 mm butt hinges - 3 Nos.

ii) 300 mm aluminum tower bolt - 2 Nos. top & bottom of Inside face

iii) 200mm anodised aluminum Pull handle - 1 No.

iv) Door stop of approved design - 1 No.

NOTE: For locks, door closures and threshold, see “Door Schedule".

### 2. Windows, Ventilators, etc.

a) Side Hung Windows

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) 12" peg stays - 1 No. per leaf

ANNEXURE-A

iii) 2 point handles - 1 No. per leaf

b) Top Hung Ventilators (Projecting Out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Adjustable sliding fabrication assembles - 2 Nos. per leaf.

iii) 2 point handles - 1 No. per leaf.

c) Bottom Hung Ventilators (Projecting in)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Concealed side arms for opening adjustment. - 2 Nos. per leaf.

iii) Spring Catch - 1 No. per leaf.

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ANNEXURE-A

## D. ALUMINIUM WINDOW, VENTILATORS, ETC.

(As per IS-1948 latest editions)

a) Side Hung Windows

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) 300 mm peg stays - 1 No per leaf

iii) 2 point handles - 1 No per leaf

b) Top Hung Ventilators (Projecting out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Adjustable sliding fabrication assembles - 2 Nos. per leaf

iii) 2 Point handles - 1 No. per leaf

c) Bottom Hung Ventilation & (Projecting In)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Concealed side arms for opening adjustment - 2 Nos. per leaf

iii) Spring Catch - 1 No. per leaf

| | TITLE: | |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR GLASS AND GLAZING** | SPECIFICATION NO. PE-TS-999-600-C006<br>VOLUME - II B<br>SECTION - D SUB-SECTION – D6<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 1 OF 5 |

# VOLUME: II B

## SECTION - D

### SUB-SECTION – D6

## GLASS AND GLAZING

## SPECIFICATION NO. PE-TS-999-600-C006

Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C006 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR GLASS AND GLAZING** | VOLUME - II B |
| | | SECTION - D SUB-SECTION – D6 |
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# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | SCOPE | 3 |
| 2.00.00 | INSTALLATION | 3 |
| 3.00.00 | ACCEPTANCE CRITERIA | 4 |
| 4.00.00 | I.S. CODES | 4 |
| 5.00.00 | RATES | 5 |

# GLASS AND GLAZING

## 1.00.00 SCOPE

This section covers supplying and fixing of all glass and glazing including all clips, putty, mastic cement etc. wherever required as per specifications.

## 2.00.00 INSTALLATION

### 2.01.00 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks, and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

**Materials:**

a) Glare reducing or beat absorbing glass shall be "Calorex" of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.

b) Clear glass shall be flat draw sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick.

c) Wired glass shall be thick- rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as required.

d) Obscure glasses shall have a cast surface in one side.

e) Coloured and figured glass shall be as per approved sample.

f) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.

g) Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.

## 2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes were six or more clips shall be used as per engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by, the Contractor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where mouldings or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contractor shall cut it to size and fix them in the same as specified above.

The Contractor shall supply necessary glazing clips, putty, mastic cement etc.

After completion of glazing, the Contractor shall remove all dirt stains, excess putty etc. clean glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the contractor’s own cost.

## 3.00.00 ACCEPTANCE CRITERIA

a) All installation shall be free from cracked, broken, or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked, or underground edges.

b) Glazing shall be carefully done to avoid direct contact with metal frames.

c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation.

d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

## 4.00.00 I.S. CODES

Following are some of the important I.S. Codes relevant to this Section:

IS: 3548 - Code of practice for glazing in building.

IS: 1081 - Code of practice' for fixing and glazing metal doors, windows ventilators.

## 5.00.00 RATES

Rates of glass and glazing if not included in respective items for supply and installation of window, ventilator, and partitions shall be paid separately as per BOQ items provided. No separate payment shall be made for glazing clips, mastic cement, putty, screws; rails, etc. nor for drilling holes in frames for inserting glazing clips.

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C007 |
|---|---|---|
| BHEL Maharatna Company | **TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS AND GRILLS** | VOLUME - II B<br>SECTION - D SUB-SECTION – D7<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 1 OF 5 |

# VOLUME: II B

## SECTION - D

### SUB-SECTION – D7

### ROLLING STEEL SHUTTERS AND GRILLS

## SPECIFICATION NO. PE-TS-999-600-C007

BHEL Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C007 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS AND GRILLS** | VOLUME - II B |
| | | SECTION - D SUB-SECTION – D7 |
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| 3.00.00 | ACCEPTANCE CRITERIA & GUARANTEE | 5 |
| 4.00.00 | I.S. CODES | 5 |
| 5.00.00 | RATES AND MEASUREMENTS | 5 |

# ROLLING STEEL SHUTTERS AND GRILLS

## 1.00.00 SCOPE

This Section covers the design and supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified.

## 2.00.00 INSTALLATION

### 2.01.00 Components

a) Slats for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters upto 4.5 M wide and not less than 1.25 mm thick for shutters having width more than 4.5 M, wide and above, machine rolled at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.

b) Rolling grills shall be constructed out of 6mm rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more than 200 centers. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6mm dia. rods.

c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise.

d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.

e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.m.

f) Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.

g) Hoods shall be formed of not less than 20-gauge steel, suitable reinforced to prevent sag.

h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as prescribed by the Engineer.

i) Power unit shall be suitable for 3 phase, 50 cycles, 400-volt A.C. power supply and be either floor or wall mounted unit. The motor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.

k) Reduction gears shall be high strength grey cast iron, machine moulded from machine out patterns.

**2.02.00 Manually Operated Shutters/Grills**

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for opening up to 9 Sq. metre in area. Larger shutters shall, be either chain and gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as desired by the Engineer.

**2.03.00 Power operated Shutters/Grills**

These shall be operable from a push button station conveniently located beside the door. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for, externally mounted shutters shall be operated by control mechanism located inside the building.

**2.04.00 Shop Coat**

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat.

**2.05.00 Erection**

Door shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer’s instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters

and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.

## 3.00.00 ACCEPTANCE CRITERIA AND GUARANTEE

### 3.01.00 Shop Inspection

After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.

### 3.02.00 Field Inspection

After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.

### 3.03.00 Guarantee

The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.

## 4.00.00 I.S. CODE

IS: 6248 - Metal rolling shutters and rolling grills.

## 5.00.00 RATES AND MEASUREMENT

### 5.01.00 Rates

Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.

### 5.02.00 Measurement

Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in “Schedule of Items”.

| | TITLE: TECHNICAL SPECIFICATION FOR MISCELLANEOUS METAL SIDING | SPECIFICATION NO. PE-TS-999-600-C008 |
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# VOLUME: II B

## SECTION - D

### SUB-SECTION – D8

### MISCELLANEOUS METAL

## SPECIFICATION NO. PE-TS-999-600-C008

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: TECHNICAL SPECIFICATION FOR MISCELLANEOUS METAL SIDING | SPECIFICATION NO. PE-TS-999-600-C008 |
|---|---|---|
| | | VOLUME - II B |
| | | SECTION - D SUB-SECTION – D8 |
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| 1.00.00 | SCOPE | 3 |
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| 3.00.00 | ACCEPTANCE CRITERIA | 7 |
| 4.00.00 | IS CODES | 8 |
| 5.00.00 | RATES AND MEASUREMENTS | 8 |

# MISCELLANEOUS METAL

## 1.00.00 SCOPE

This section covers supply, fabrication and erection of miscellaneous metal items of light nature in gates, balcony and stair hand rails, structural works, ladders, hangers, masonry anchors, anchor bolts, fasteners, chain link fencing, barbed wire fencing etc. as specified or shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast of mild steel, aluminium, brass, cast iron, M.S.& galvanized M.S. sheets, aluminium sheets, expanded metal, wire mesh as shown on drawings or specified.

## 2.00.00 INSTALLATION

### 2.01.00 Fabrication/casting

### 2.01.01 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop.

### 2.01.02 Shop Connections

a) All shop connections shall be riveted or welded except when noted otherwise on drawings.

b) Welding of steel shall be done in accordance with IS: 816.

c) Welding of aluminium shall be done accordance with IS: 2812, “Arc welding of Aluminium and Alloys.” Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

### 2.01.03 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill seals, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied be brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified steel work shall be galvanised or painted with a coat of zinc chromate primer. Aluminium surfaces, which shall come in contact with masonry, shall be given one coat of bituminous paint.

**2.02.00 Erection**

**2.02.01 Bracing**

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected, including erection of equipment and operation of the same.

**2.02.02 Temporary Bolting-Up**

As erection proceeds the Contractor shall plum up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever erection equipment or other loads are carried by members during erection, proper provision shall be made to take care of the stresses resulting from the same.

**2.02.03 Turned Bolt**

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

**2.02.04 Welding**

Where specified on drawings, welding shall be done in accordance with IS: 816 for steel and IS: 2812 for Aluminium & Alloys.

**2.02.05 Cutting and Fitting**

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, then those shown on drawings, shall be made without the approval of the Engineer.

**2.02.06 Drifting**

Correction minor misfits and a reasonable amount of reading and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections, reaming that weakness the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount or reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer-and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

**2.02.07 Spot Painting**

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

**2.02.08 Good**

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

**2.02.09 Grouting**

All bearing plates, loose, lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1½:3 concrete with 6 mm down stone chips or as specified in schedule of items.

**2.02.10 Anchor Fasteners**

The anchor fasteners shall be of two type viz. light duty for carrying tensile load upto 0.5MT per fasteners and heavy duty for carrying tensile load of 0.5MT to 5.0MT per fasteners. These anchor fasteners shall be fixed into concrete. The Contractor shall submit the Manufacture’s literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position strictly as per the manufacturer’s instructions and as approved by the Engineer.

**Heavy Duty Anchor Fasteners**

The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of capacity of 2.5 for the characteristic load of the anchor. Minimum size of anchor shall be M8 (8mm). All anchors shall be from the approved manufacturers like HILTI or equivalent.

a) Anchor fasteners shall be supplied and fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
b) Capacity of the anchor shall be established after considering the effect of concrete grade, embedment depth, concrete thickness, anchor spacing and edge distance from the concrete edge.

c) The selection for the particular type of bonding for the anchors shall be made after considering the concrete grade, available embedment depth, load to be transferred, space available for installing anchors.
d) The mechanical bonding anchor are torque controlled anchors made from carbon steel of grade 8.8 as per IS:1367 part 3. Anchors in bolt as well as nut version are acceptable. The bolt version anchors consist of bolt washer, sleeves, plastic section, expansion sleeves and a cone. Nuts version anchor consists of nuts, threaded rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to minimum 5 micron coating thickness. The plastic section shall be of polyacetal Derlin 100 or equivalent.
e) Chemical bonding anchor shall consist of foil capsule and threaded rod. The foil capsule shall contain the resin and hardener. The threaded rod shall have chiselled tip. The behaviour of anchors under fire shall conform the heating curves as per ISO:834. Anchors of size M8 to M24 shall conform to grade 5.8 and anchors of size M27 to M39 shall conform to grade 8.8 as per IS:1367 part 3. All steel components of the anchors shall be electro-galvanised to minimum 5-micron thickness.

**Light Duty Anchors**

This anchor shall comprise of stud, nut, washers, expansion sleeve. The one end of the stud shall have thread and the other end shall have cold formed conical head. All steel components of the anchors shall be electro-galvanised to minimum 5-micron thickness. The expansion sleeve shall preferably be of stainless steel of SS316. The anchors shall conform to minimum grade 5.8 as per IS:1367 part 3.

**2.02.11 Pipe Joints**

MS pipes or GI pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot joined and caulked with hemp and molten head.

**2.03.0 FENCING**

**2.03.01 Chain Link Fencing**

The material requirement shall conform to IS: 2721 latest edition. The chain link fencing shall be woven from 3.15mm dia. wire with mesh size of 50mm. The mesh wire shall not vary from specified dia. by more than $\pm$0.05mm. all steel wire shall be hot dipped galvanised wire. The Dia. shall be measured over the galvanised coating. The line wire shall be 4.0mm dia. mild steel. The stirrup wires for securing the line wire to the intermediate post (RCC/structural steel) shall be 2.5 mm diameter mild steel. The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter mild

steel. Hair pin chain staples for fastening down the bottom of galvanised chain line fencing to the concrete sill shall be 3.15mm wire. The ends shall be bent outwards for securing anchorage.

Cleat for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 8 mm. The eye bolts strainer shall consist of bolt with welded eye sufficiently threaded and fitted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts fitted after the wires have been strained on one side. Stretcher bar shall consist of mild steel flats 25 x 4.75 mm. They shall be secured to the cleats by steel bolts.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining posts by means of a stretcher bar. One of top line wire shall be threaded through appropriate adjacent row of mesh, care being taken that no meshes in the row are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced at 150mm apart and to the other middle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:
Continuous concrete sill 125mm wide x 225mm high for full length between posts shall be cast with the top 25mm above GL and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 750mm c/c and set in the sill to a depth of 150mm.

**2.03.02 Barbed Wire Fencing**

The barbed wire shall be conforming to IS:278 latest editions. The barbed wire shall be galvanised and galvanising shall conform to the requirement laid down for ‘light-coated wire’ of IS:4826 and it shall be smooth and relatively free of lumps etc. Wire with excessive roughness blisters, salammoniac spots shall be rejected. The barbed wire shall be made from two-line wire and two-point wire of 2.5 mm thickness each. The barbs shall have four point and shall be formed by twisting two point wires, each two turns, tightly around both or one-line wire (Type A - around both line wire, Type B - around one-line wire) making altogether four complete turns. The barbs shall be so finished that four points are set and located or locked as far as possible at right angle to each other. The barbs shall have a length of not less than 13mm and not more than 18mm. The distance between two barbs shall be 75$\pm$12mm.

Straining posts shall be provided at all ends and corners of fences or at changes in direction or acute variation in level and at intervals not exceeding 66 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four

evenly spaced row of line wire in all. The top line wire shall be doubled, making five-line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wire so that they could not be bunched together. Droppers for barbed wire shall be of mild steel of not less than 25 x 4.75 mm thick with 38 x 4.85 mm half round staples for fastening the barbed wire to them. Bracing for the rows of barbed wire shall be approved by the Engineer.

## 3.00.00 ACCEPTANCE CRITERIA

a) All items shall be correct shape, size, weight etc. shown on drawings and schedule of items.

b) For installed items, the tolerances shall be as follows

   i) Permissible deviation from, straightness – 1 in 1000.

   ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.

c) All castings shall be free from blowholes, cracks, and other blemishes.

d) All MS wire fencing shall be in true vertical plain, and shall not bulge.

## 4.00.00 IS CODES

| | |
|---|---|
| IS:278 | Specification for Galvanized Steel Barbed wire for fencing. |
| IS:816 | Code of practice for use of Metal Arc welding for general construction in mild steel. |
| IS:1367 | Industrial Fasteners – Threaded steel fasteners - Technical supply condition. |
| IS:2721 | Specification for Galvanized Steel Chain Link fence fabric. |
| IS:2812 | Arc welding of Aluminum and Alloy |

## 5.00.00 RATES AND MEASURMENTS

### 5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items.
Rate for fencing shall also include excavation, concreting and supply, erection & fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded.

### 5.02.0 Measurements

Measurement for MS gates shall be in MT.

Measurement for galvanised MS wire fencing shall be in Sqm.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.

| | TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS | SPECIFICATION NO. PE-TS-999-600-C009 |
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# VOLUME: II B

## SECTION - D

## SUB-SECTION – D9

## MASONRY AND ALLIED WORKS

## SPECIFICATION NO. PE-TS-999-600-C009

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS | SPECIFICATION NO. PE-TS-999-600-C009 |
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| 4.00.00 | I.S. CODES | 10 |
| 5.00.00 | RATES AND MEASUREMENTS | 11 |

# MASONRY AND ALLIED WORKS

## 1.00.00 SCOPE

This section covers furnishing, installation including handling, transporting, batching, mixing, laying scaffolding, centering, shuttering, finishing, curing, protection, maintenance and repair of common building materials till handing over of masonry and allied works for use in structures and locations covered under the scope of this package.

## 2.00.00 MATERIALS

a) Brick

Bricks for general masonry work shall be of class designation 7.5 of nominal dimensions as per standard specification under IS: 1077, well burnt, of uniform size, shape and colour, free from cracks, flaws or modules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps holes etc. Water absorption after 24 hours' immersion shall not exceed 20% by weight for bricks. Dimensional tolerance shall not exceed 8% of the size shown in drawings for bricks. All bricks shall have rectangular faces and sharp straight edges. The bricks shall show no efflorescence after soaking in water and drying in shade.

Each brick shall have the manufacturer's identification marks clearly marked on the frog. Representative samples shall be submitted and approved samples shall be retained by the Engineer for further comparisons and reference. Any brick not found up to the specification shall be removed immediately from site at the Contractor's own cost.

Bricks shall not be dumped at site. They shall be stacked in regular tiers, even as they are unloaded; to minimize breakage and defacement of bricks. Bricks selected for different situation of use in the work shall be stacked separately.

b) Stone

All stones shall be obtained from approved quarries, hard, tough, durable compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean, and sharp and shall show uniformity of texture, without loose grains and free from any dull, chalky, or earthly appearance. Stone showing mottled colours shall not be used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours'

immersion. The type of stone shall be as specified on drawings and/or instructed by the Engineer. Samples shall be submitted by the Contractor and approved samples shall be retained by the Engineer for comparison of bulk supply.

c) Cement

Cement used shall be Ordinarily Portland Cement or Portland Slag Cement or Portland Pozzolana Cement conforming to IS Codes and shall be fresh when delivered. In special cases, Rapid Hardening Portland Cement, Low Heat Cement etc. may be permitted or directed to be used by the Engineer. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Contractor is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The Contractor shall also have no claim for this type of suspension of work.

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the Contractor and shall be removed from the site immediately.

d) Coarse Aggregate

Coarse aggregates shall be as per IS: 383 latest editions, consisting of hard, strong and durable pieces of crushed stone and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles etc. and any other material liable to affect the strength, durability or appearance of concrete.

Aggregates other than crushed stone conforming to the provisions of specification may be used if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer.

Grading of coarse aggregates shall generally conform to IS: 383 and shall be such as to produce a dense concrete or the specified proportions and strength and of consistence that will work readily into position without segregation.

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass, or any other injurious substances at any stage.
Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

e) Sand

Sand shall be hard, durable, clean, and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosion to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded and shall be as per relevant IS Code. Sand for concrete shall conform to IS: 383.

f) Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discoloration, efflorescence etc.

g) Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings, which may impair proper bond. Structural steel shall conform to IS: 2062. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement shall conform to IS: 432. Cold twisted steel bars shall conform to IS: 1786. Hand drawn steel wire fabric shall conform to IS: 1566. Hexagonal wire netting shall conform to IS: 3150. All steel bars including and above 10 mm diameter shall be of tested quality. All wire netting shall be galvanized.

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary, a coat of cement wash shall be given to the bars to guard against rusting.

## 3.00.00 INSTALLATION

### 3:01.00 Soling

### 3.01.01 Brick Soling

The ground shall be dressed, consolidated by ramming, or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. The pattern of laying and number of layers shall be as per Schedule of item. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

### 3.01.02 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling specified in the Schedule of Items. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

### 3.02.00 Brick-on-Edge

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

### 3.03.00 Masonry

### 3.03.01 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

### 3.03.02 Cement Mortar

Cement mortar shall be prepared with materials specified in clause 2.00.00. Sand for masonry mortar shall conform to IS: 2116. Cement and sand in the specified proportion shall be mixed dry thoroughly and minimum water added to attain required workability.

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar, which has stood for more than half an hour, shall be used.

### 3.03.03 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

### 3.03.04 Exposed Brickwork

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by especially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule, and string. All brickwork shall be cleaned at the end of days' work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean, and pointed as specified. Where face bricks are used carborundum stone shall be used for rubbing down.

### 3.03.05 Reinforced Brickworks

Reinforcements shall be as specified. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.

### 3.03.06 Stone Masonry

Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area.

### 3.03.07 Exposed Stone work

Stonework, which is to be kept exposed, shall be as shown on approved drawing. It shall be executed by especially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 Sq.M. area shall be built and approved by the Engineer and all works shall match with this sample.

### 3.03.08 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

### 3.03.09 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

### 3.03.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with Carborundum stone.

### 3.03.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days' work top surface of masonry shall be kept wet by ponding.

### 3.03.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

### 3.03.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

### 3.04.00 Damp Proof Course (DPC)

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1½:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double Chequered and cured by ponding for seven days.

### 3.05.00 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS: 1609. The number of courses shall be as shown as drawings or as specified. Sequence of work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged, at his own expense, to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing, damp proof membrane with one-layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

## 3.06.00 Plinth Protection

Plinth of buildings shall be protected with brick-on-edge paving of minimum 750mm width unless otherwise shown on the drawings. The treatment shall consist of laying bricks in cement mortar 1:6 (1 cement: 6 sand) over a 75mm thick bed of dry graded brick aggregate, 40mm nominal size, grouted with sand. The top shall be finished with 1:2 cement mortar pointing (1 cement: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50. The brick aggregate shall be well graded, broken from well burnt or slightly over burnt and dense brickbats. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign matter.

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. The bed shall be watered and rammed with heavy iron square rammers. Surplus earth, if any, shall be disposed off beyond a lead of 50m or as directed by the Engineer.

Over this, 75mm thick bed of aggregate of 40mm nominal size, shall be laid with a minimum outward slope of 1 in 50. Aggregates shall be carefully laid and packed, bigger sized being placed at the bottom. The brick aggregates shall be consolidated dry with heavy iron rammers.

The aggregates shall then be grouted evenly with sand at the rate of 0.6 cubic metre per square metre area, adequately watered to ensure filling of voids by sand and again rammed with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been compacted thoroughly, brick flooring with bricks of specified strength in cement mortar 1:6 (1 cement: 6 sand) shall be laid.

The bricks shall be laid on edge in Diagonal/Herring Bone Bond or other pattern as specified or as directed by the Engineer. Bricks shall be laid on 12mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with handle of trowel or wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.

The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.

Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.

## 4.00.00 I.S. CODES

Some of the important relevant codes for this section are:

IS: 1127: Recommendations for dimensions and workmanship of natural building stones for masonry work.

IS: 1597: Code of Practice for Construction of stone Masonry.

IS: 1609: Code of Practice for laying Damp proof treatment using bitumen felts.

IS: 2212: Code of Practice for Brickwork.

IS: 2250: Code of Practice for preparation and use of masonry Mortar.

IS: 5134: Bitumen Impregnated Paper & Board.

## 5.00.00 RATES AND MEASUREMENTS

### 5.01.00 Rates

Unit rate for masonry work shall include the following:

a) Raking out joints for plastering or pointing or finishing the joint flush as the work proceeds.

b) Preparing top sand sides of existing wall for joining old with new work.

c) Providing, dismantling and removing the scaffolding.

Unit rate for DPC shall be inclusive of formwork and bitumen painting.

**5.02.00 Measurement**

Brickwork in wall of half brick thickness shall be measured separately in Sqm stating the wall thickness and more than half brick thickness shall be measured by volume. Plaster thickness shall not be considered for computation of volume.

Masonry work in sub structure and super structure shall be measured separately, unless otherwise specified in the Schedule of items.

No deductions shall be made and no extra payment shall be made for following:

a) Opening upto 0.1 Sqm each in area. In calculating the area of the opening lintels or sills shall be included along with the size of the opening.

b) Drainage holes and recesses for cement blocks to embed holdfasts for doors, windows etc.

c) Pipe and fixtures upto 300mm dia. and nothing extra shall be paid for the mortar used for fixing.

d) Ends of dissimilar materials (i.e. joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc.); up to 0.1 sqm in section;

e) Chases of section not exceeding 50 cm in girth;

f) Iron fixtures, such as wall ties and hold fasts for doors and windows;

g) Cement concrete blocks as fcr hold fasts and holding down bolts;

h) Wall plates, bed plaros, and bearing of slabs, CHAJJAS and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

Reinforcement in masonry work shall be paid separately under respective items.

Damp proof course shall be measured in Sqm. No deduction shall be made and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be measured under respective item of works executed required for completion of the work as specified.

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# VOLUME: II B

## SECTION - D

## SUB-SECTION – D10

## FINISH TO MASONRY AND CONCRETE

## SPECIFICATION NO. PE-TS-999-600-C010

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE | SPECIFICATION NO. PE-TS-999-600-C010 |
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# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
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| 1.00.00 | SCOPE | 3 |
| 2.00.00 | INSTALLATION | 3 |
| 3.00.00 | ACCEPTANCE CRITERIA | 8 |
| 4.00.00 | I.S. CODE | 8 |
| 5.00.0 | RATES AND MEASUREMENTS | 9 |

# FINISH TO MASONRY AND CONCRETE

## 1.00.00 SCOPE

This Section covers finishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items, the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

## 2.00.01 INSTALLATION

### 2.01.00 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be rushed down with stiff wire brush to remove all loose dust from joints and thoroughly, washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

## 2.02.00 PLASTERING

### 2.02.01 Mortar

Mortar for plastering shall be as specified.
For sand cement plaster, sand and cement in the specified proportion shall be

mixed dry, on a watertight platform and minimum water added to achieve working consistency. The sand for plaster shall conform to IS: 1542.

No plaster, which has stood for more than half an hour, shall be used; plaster that shows tendency to become dry before this time shall have water added to it.

### 2.02.02 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat; the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

**2.02.03 Finish**

Generally, the standard finish shall be used unless otherwise Shown on drawing or directed by the engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the engineer regarding the texture, color and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough; otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.02.02 but using Coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the topcoat only shall be made with coloured cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS: 2114 latest editions.

Samples of colouring material shall be submitted to the engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1-part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.02.02. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20mm as approved by the

Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of oil a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-cast Finish

A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) Scraped Finish

Ordinary plaster as described under Clause 2.02.02 after being leveled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1-part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2 Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

h) Sand Faced Plaster

The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item or work. The scratch coat shall be cured for at least 7 days & then allowed to dry. The second coat shall be 6mm thick and it shall not be applied until at least 10 days have elapsed after the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation & without joints; finish shall be straight, true, & even. The mortar of this coat shall be as specified under the respective item of work. White sand for finish shall be used for the second coat & for finishing work. Sand for finish shall be of even coarse size & shall be dashed on the surface & sponged.

**2.02.04 Curing**

All plastered surfaces after laying shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

**2.03.00 Pointing to masonry**

All Joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1-part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scalped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

**2.04.00 Plaster with Metal Lath**

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two-layers. The mortar for plastering shall consist of 1-part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.02.01. The application, finish etc. shall be as specified under relevant clause above. Where called for a 2 mm Plaster of Paris punting shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

**2.05.00 Lime Punning**

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the

lime punning. The punting shall be applied by skilled workman and given a smooth and ever finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

**2.06.00 Plaster of Paris Punning**

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. areas and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

**2.07.00 Stone Facing**

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawings for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall. not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1-part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.

## 3.00.00 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

## 4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 1661: Code practice for cement and cement-lime plaster finish on wall & ceilings.

IS: 4101: code of practice for external facings and veneers.

## 5.00.00 RATES AND MEASUREMENT

### 5.01.00 Rates

Rates shall also include providing, dismantling and removing of scaffolding, surface preparation, curing and all type of surface, shapes/ profiles and at all elevations.

### 5.02.00 Measurement

All plastering shall be measured net (on surface area on which it is applied) in Sqm. Plaster work shall be classified according to the type used and shall be measured separately. Plaster on ceiling and walls shall be measured separately. Soffits of stairs shall be measured as plastering on ceiling.

No deduction shall be made for opening not exceeding 0.5 Sqm and for ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sills of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

| | TITLE: TECHNICAL SPECIFICATION FOR PAINTING, WHITEWASHING, POLISHING | SPECIFICATION NO. PE-TS-999-600-C011 |
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# VOLUME: II B

## SECTION - D

### SUB-SECTION – D11

# PAINTING, WHITEWASHING, POLISHING

## SPECIFICATION NO. PE-TS-999-600-C011

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: TECHNICAL SPECIFICATION FOR PAINTING, WHITEWASHING, POLISHING | SPECIFICATION NO. PE-TS-999-600-C011 |
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| | | SECTION - D SUB-SECTION – D11 |
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# C 0 N T E N T


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# PAINTING, WHITE WASHING, POLISHING, ETC.

## 1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of Paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

## 2.00.00 INSTALLATION

### 2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer’s test certificate. All paint shall be subject to analysis from random samples taken at site from painter’s bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of white wash water and a little of indigo or synthetic ultramarine blue shall be added to the lime. Mineral colour not affected by lime shall be added to white wash to get the required tint/shade approved by the Engineer.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water-soluble binders etc. and share conform to IS: 427. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacture. Only sufficient quantity of distemper required for a day's work shall be prepared.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type containing suitable preservatives and shall conform to IS: 428. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS: 5410.

e) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to IS: 5411 (Part-1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour, or without showing flaking, blistering, or peeling.

f) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not be yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well-known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as finishing coat on wood after the woods pre-treated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

j) Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

**2.00.02 Storage**

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

**2.01.00 Preparation of surface**

Before starting the work, the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.

**2.01.02 Wood**

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

**2.01.02 Masonry, Concrete, and Plastered Surface**

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

**2.01.03 Metal**

The surface preparation shall be done in accordance with IS:1477 (Part-1) ‘Code of practice for painting of ferrous metals in building’ and as directed by Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc. and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrappers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pre-treated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.

## 2.02.00 Application

## 2.02.01 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor notes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to free of sags, runs, crawls, or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoat for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered property by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall, be done as per IS: 1477 (Part I & 2). The total dry thickness of film should not be less than 120 Micron.

**2.02.02 White Washing**

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before white washing.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

**2.02.03 Dry Distemper**

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1-part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distempering shall be done as per manufacturers instruction. In applying the distempers, the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

**2.02.04 Oil bound washable distemper**

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

**2.02.05 Waterproof Cement Paint**

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

**2.02.06 Acrylic Emulsion Paint**

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conforming to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.

**2.02.07 Synthetic Enamel Paint**

Shall be applied on properly primered surface. Sub sequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

**2.02.08 Aluminium Paint**

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

**2.02.09 Clear Synthetic Varnish**

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a

hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

**2.02.10 French polish**

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted. The pores in the shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemme or umber.

After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit, and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

**2.02.11 Chemical Resistant Paint**

For chemical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer's recommendation shall be followed regarding the paint system, exposed to moderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

**2.03.00 Protection**

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

**2.04.00 Cleaning up**

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

## 3.00.00 ACCEPTANCE CRITERIA AND TESTING

a) All painted surfaces shall be uniform and pleasing in appearance.

b) All varnished surfaces shall be of uniform texture and high glossy finish.

c) The colour, texture etc. shall match exactly with those of approved samples.

d) All stains, splashes, and splatters of paints and varnishes shall be removed from surrounding surfaces.

**Testing**

a) As, each part of the work is under progress, i.e. preparation of surface, providing primer, providing different coats of finishing paints, it shall be passed by the Engineer. Variation from the drawings or specification or standard etc. shall not be accepted. The Contractor shall ascertain from the Engineer as to which parts will be inspected and passed from time to time. The Contractor shall provide all necessary arrangement for inspection of the painting work during its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and satisfaction of the Engineer. All the necessary cost for scaffolding, approach, platform, lighting arrangement testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exonerate the Contractor from his responsibilities for proper workmanship, material etc.

b) The Contractor shall carry out all sampling and necessary testing in accordance with the relevant Indian Standards and shall conduct such tests as called for by the Engineer. Where no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practice as per the direction of the Engineer. Tests shall be done in a laboratory, approved by the Engineer, and cost of testing shall be borne by the contractor.

c) Material/workmanship unsuitable for acceptance shall he removed and replaced by the Contractor. The work shall be redone as per Specification of the contract and direction of the Engineer without extra cost to owner.

## 4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

| | |
|---|---|
| IS: 348 | Specification for French polish |
| IS: 427 | Specification for Distemper, dry colour as required. |
| IS: 428 | Specification for Distemper oil emulsion, colour as required. |
| IS: 1477 (I & II) | Code of Practice for painting of ferrous metal in buildings. |

| | |
|---|---|
| IS: 2338 (I & II) | Code of Practice for finishing of wood and wood based materials. |
| IS: 2339 | Specification for Aluminium, Paints for general purposes in dual containers. |
| IS: 2395 | Code of Practice for painting concrete, masonry, and Plaster surface. |
| IS: 2932 | Specification for enamel, exterior type-1. |
| IS: 5410 | Specification for cement paint, colour as required. |

## 5.00.00 RATES AND MEASUREMENT

### 5.01.00 Rates

Rates shall be unit rates for complete items described in the "Schedule of Items".

Rate shall include cleaning, preparation of surface, supply and application of primer, painting and providing all protection and scaffolding required at site.

### 5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be increased by 15%.

Painting of structural steel works shall be measured in M.T. of fabricated steel (as per section D-17 clause 6.02.00 i.e. Mode of measurement of technical specification for fabrication of structural steel works) unless specified otherwise.

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C012 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR FLOOR FINISH AND ALLIED WORKS** | VOLUME - II B |
| | | SECTION - D \| SUB-SECTION – D12 |
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# VOLUME: II B

## SECTION - D

## SUB-SECTION – D12

# FLOOR FINISH AND ALLIED WORKS

## SPECIFICATION NO. PE-TS-999-600-C012

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Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C012 |
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| Maharatna Company | **TECHNICAL SPECIFICATION FOR FLOOR FINISH AND ALLIED WORKS** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D12<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 2 OF 22 |

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| 5.00.00 | RATES AND MEASUREMENTS | 21 |


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# FLOOR FINISH AND ALLIED WORKS

1.00.0 SCOPE

This section covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes, and allied items of work as listed below

a) In Situ Finishes

i) Integral finish to concrete base

ii) Terrazzo finish

iii) Granolithic finishes

iv) Patent Stone

v) Metallic Hardener like “Ironte”/Hardonate Finish

vi) Mastic Asphalt finishes

vii) Chemical Resistant finish

b) Tiled Finishes

i) Terrazzo tile

ii) Chequered tile

iii) Glazed tile

iv) Tesse rae (Mosaic etc.)

v) Chemical Resistant

vi) Rubber, Vinyl etc.

vii) Stone Slab including Kota Stone.

**1.01.00 Base**

The base to receive the finish is covered under other relevant specifications.

**1.01.01 Sequence**

Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of other agencies working in that area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damages whatsoever till handing over.

**2.00.00 INSTALLATION**

**2.00.01 Special Materials**

Basic materials are covered elsewhere under the Specification. In general, all such materials shall be as per relevant Codes where available. In all cases these materials shall be of the best quality available indigenously unless specified otherwise.

The materials for finishing items must be procured from well-reputed specialized manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.

**2.00.02 Workmanship**

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Only workers specially experienced in particular items of finishing work shall be engaged, where such workers are not readily available, with the Engineer's permission, experienced supervisors recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires the Contractor shall get the finishing items installed by the manufacturer.

**2.00.03 Preparation of the Base Surface**

The surface to be treated shall be thoroughly examined by the Contractor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirts, grease etc. with water and hard brush and

detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification.

To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.
The surface shall be bone dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as per the acceptability of the surface.

**2.01.00 In Situ Finishes**

**2.01.01 Integral Finish to Concrete Base**

While the surface of the concrete laid as per specification for 'Cement Concrete' has been fully compacted and levelled but the concrete is still `green' thick slurry, made with neat cement shall be applied evenly and worked in with iron floats. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark or undulations. This finish shall be as thin as possible by using 2.2 kg. of cement per Sq.M. of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected to any load or abrasion till 21 days after lying.

As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings, the marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

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**2.01.02 Terrazzo Finish in Situ**

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the 'finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the underbed may very in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to achieve the specified thickness. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) Mix

i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 parts cement, 1½ parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1-part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Topping

The mix for the topping shall be composed of cement, colour Pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or gray or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1-part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1½ parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and nonfading. It must be very finely ground. The marble powder shall be from White marble and shall be finer than IS Sieve No.: 30. The size of marble chips shall be between 1 mm to 20 mm. Sufficient quantity to cover each visible area shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set.

c) Laying

The underbed shall be laid in panels. The panels shall not be more than 5 Sq.M. in area of which no side shall be more than 2.5 M. long. For exposed locations the maximum area of a panel shall be 2.0 Sq.M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbed plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat “green” but firm enough to receive the

topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in an even pattern of distribution.

d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polish

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.80) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. A suitable machine shall do the grinding. Where grinding machine cannot be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.:60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried, and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be postponed till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M., water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy, but not slippery.

## 2.01.03 Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix

The mix shall consist of 1-part cement, 1-part coarse sand, 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification “Cement Concrete” and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully -green- the topping shall be laid evenly to proper thickness and grade. If considered necessary, the surface ‘of the base shall roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then the lightly trowelled to remove all, marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 Sq.M. area. The panels shall be laid in chequered board pattern.

d) Laying of Topping Separately on Hardened Base

The base concrete shall be prepared as stated in clause 2.00.03 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or pounding of water on the surface. The floor shall not be exposed to heavy traffic during this period.

f) Grinding

If grinding is specified, it shall start only after the finish has fully set. Clause 2.01.02 (e) shall be followed. However, the Engineer shall decide upon the ultimate polish required.

g) Finishing

Where specified, sodium, silicate or magnesium or zinc silico fluoride treatment shall be done. The number of coats to be applied shall be as per approved drawings or as instructed. The concentration and method of application of the solutions shall be as specified in IS: 5491.

**2.01.04 Patent Stone**

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a) Thickness

The patent stone finish shall have thickness as stipulated under clause 2.01.02 (a) except that the topping shall be 12 mm thick.

b) Mix

i) Underbed

The mix shall be as stipulated under clause 2.01.02 (b).

ii) Topping

The mix for the topping shall consist of 1-part cement and 2-part stone aggregate 6mm nominal size by volume.

c) Laying

The Patent Stone finish including the underbed shall be laid in alternate bays or in Chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 Sq.M. of which no side shall be more than 2 M. long.

A cement grout shall be applied and worked into the surface to receive the finish; the underbed then laid, compacted, and leveled to proper grade with

a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.

### 2.01.05 Metallic Hardener Like 'Ironite'/ `Hardonate' Finish

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is `green'.

a) Thickness

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.

b) Material

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials when desired by the engineer, actual samples shall be tested.

c) Mix

Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry, with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1-part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d) Laying

The concrete floor shall be laid as per specification 'Cement Concrete' and levelled upto required grade. The forms, if any, shall remain sufficiently projecting to make the finish. The surface shall be roughened by wire brash as soon as possible.

The finish shall be laid while the concrete underbed is still very `green' within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigoursly and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smoothened with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.

## 2.01.06 Mastic Asphalt Finish

This is a one-layer treatment on concrete or brick base.

a) Thickness

The thickness shall be as specified in the drawing.

b) Materials

Bitumen shall be industrial Bitumen of the grade 90/15 and 75/15 conforming to IS: 702.

Mineral filler shall be dry stone dust passing through 75 micron IS Sieve.

Fine aggregate shall be crushed and graded natural limestone or other hard work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish upto 20 mm thick & 10 mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform IS: 1195 and shall be either brought to site in blocks weighing about 25 Kg or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly, incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) Laying

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be levelled and when cooled to some extent shall be finished with a wooden float with addition of small

quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.

The mastic shall be laid in suitable panels of about 1.5 Sq.M. in area each formed by formers. Succeeding panels shall be laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint.

**2.01.07 Chemical Resistant in Situ Finish**

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The contractor shall get it done by a specialized Manufacturer and get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

**2.02.00 Tiled Finish**

These shall include finish tiles, stone slabs, and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer.

**2.02.01 Terrazzo Tile Finish**

The finish will consist of manufacture terrazzo and an underbed.

a) Thickness

The total thickness including the underbed shall be minimum 40 mm for floors 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tile shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.

Each tile shall bear on its back permanent and legible trademark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be ± 1 mm and the

thickness ± 3 mm. Face of the tile shall be plane, free from pinholes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm.

The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The backing shall be composed of 1 part ordinary gray cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.01.02 (b).

The tile shall be cured at the shop for at last 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c) Mix: Underbed

The underbed for floor and similar horizontal surfaces shall be 1-part lime putty: 1 part surkhi: 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1-part cement and 3 parts coarse sand by weight.

d) Laying

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The

joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect.

When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.01.02(c) may be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be same as Clause 2.01.02(e). Grinding shall not commence earlier than 14 days after laying of tiles.

**2.02.02 Chequered Tile Finish**

The finish shall consist of manufactured gray or coloured cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a) Thickness

Thickness shall be same as in clause 2.02.01 (a).

b) Tiles: Chequered

The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm. c/c. Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.02.01 (b) except that these may have the topping in terrazzo or plain gray cement or colour pigment added to cement.

c) Under-bed
As per clause 2.02.01 (c).

d) Laying
As per clause 2.02.01 (d).

e) Grinding and Polishing

As per clause 2.02.01 (e) except that the tiles shall be ground and polished by hand and after laying taking special care in polishing the grooves properly and uniformly.

**2.02.03 Glazed Tiles Finish**

This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base.

a) Thickness

The total thickness shall be between 20mm and 25mm including the underbed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

b) Tiles: Glazed

The tiles shall be of earthenware, covered with glaze white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes and 5.5 mm to 6 mm on thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness specials like internal and external angles; beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt, unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawling, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

c) Mix: Underbed

The mix for the underbed shall consist of 1-part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

c) Laying
Same as clause 2.02.01 (d).

e) Finishing

The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully, and wiped with soft cloth to prevent scratching before handing over.

**2.02.04 Tesserae Finish (Mosaic etc.)**

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

a) Thickness

The total thickness including the underbed shall be between 16 mm & 25 mm.

b) Tesserae Finish

These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass, or similar hard wearing, strong, and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.

c) Mix: Underbed
Same as clause 2.02.03 (c)

d) Laying

The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.02.03 (d) shall generally be followed. However, instead of gray cement the slurry shall be made with white cement to fix the panels. The paper-

mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.

**2.02.05 Chemical Resistant Tiled Finish**

This shall include all verities of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles shall be of the best indigenous Manufacture unless otherwise specified and shall be resistant to the chemical (both acid and alkali). The tiles shall have straight edges, uniform thickness, plain surface, uniform nonfading colour, and textures.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 $Kg/cm^2$. The surface shall be abrasion resistant and durable.

b) Laying

The mortar used for setting or for underbed these tiles shall be durable, strong and chemical resistant epoxy mortar. The grout, which shall be to the full depth of tile, shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

**2.02.06 Rubber, Vinyl, or Vinyl Asbestos Tiles Finish**

This shall include various types of tiles manufactured from rubber, vinyl etc. set with an adhesive on concrete or masonry base. An underbed may be required to secure desirable surface and grade.

a) Thickness

The thickness of the tiles shall be as incorporated in drawing.

b) Tiles

Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be ± 1.5 mm.

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be nonfading and uniform in appearance, insoluble in water and resistant to alkalies, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer's trademark, the thickness, sizes, batch number, and date of manufacturer.

Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c) Mix: Underbed

The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part like putty:1-part cement: 3 parts coarse sand mixed with just sufficient water to make it workable.

d) Laying

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air-conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The

joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried, and polished with an approved type of polish just before handing over.

**2.02.07 Stone Slab Finish: Marble, Stone, and Similar Fine Grained Stone including Kota stone**

a) Thickness

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs will be 20 mm thick.

b) Stone Slab

The stone slabs shall be made from selected stock, which is hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of ± 5 mm in dimensions and ± 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c) Mix: Underbed
Same as clause 2.02.01 (c).

d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed, and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to

stiffen a little. Next, thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, gray / white / mixed with pigment matching the colour of the stone slabs. The slab shall

be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.

e) Polishing, Finishing

Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under clause 2.02.01 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

**2.02.08 Stone Slab Finish: Sand Stone and Similar Coarse Grained Stone Finish**

Generally, clause 2.02.07 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fine chiselled as specified. Tolerance may be allowed upto ± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiselling the unevenness shall be limited to ± 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement. If fine joints in the flooring are specified, the edges of slabs shall be cut in such a way that it shall form an inverted ‘Y’.

**3.00.00 ACCEPTANCE CRITERIA**

The finish shall be checked specially for:

a) Level, Slope, Plumb as the case may be

b) Pattern and Symmetry

c) Alignment of joints, dividing strip etc.

d) Colour, texture

e) Surface finish

f) Thickness of joints

g) Details at edges, junctions etc.

h) Performance

i) Precautions specified for durability

## 4.00.00 I.S. CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

| | | |
|---|---|---|
| IS: 777 | : | Glazed earthenware tiles |
| IS: 1196 | : | Code of practice for laying bitumen mastic flooring. |
| IS: 1197 | : | Code of practice for laying of rubber floors |
| IS: 1237 | : | Cement concrete flooring tiles |
| IS: 1443 | : | Code of practice for laying and finishing of cement concrete flooring tiles. |
| IS: 2114 | : | Code of practice for laying in situ terrazzo floor. |
| IS: 3461 | : | PVC asbestos floor tiles |
| IS: 4860 | : | Specification for acid resistant bricks |
| IS: 5518 | : | Code of practice for laying of flexible PVC Sheet and tile flooring. |
| IS: 5491 | : | Code of practice for laying in situ granolithic floor topping. |

## 5.00.00 RATES AND MEASUREMENT

### 5.01.00 Rates

Rates shall be for the complete work (including dividing strips, Ironite, metals, tiles etc. if any) as per the schedule of items. Rates shall be applicable for application on horizontal and vertical surfaces at all elevations and for all types of work including stairs tread and riser, laying in desired pattern and panels, cost of specials (if any) rounding of corners, mouldings etc.

Rates shall be including provision of side shuttering (if required) for casting of floor in alternate panels and or without dividing strips.

### 5.02.00 Measurement

The finished surface shall be measured in Sqm for area unless otherwise specified. Deduction shall not be made for opening or embedded articles having area not exceeding 0.1 Sqm.

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| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C013 |
|---|---|---|
| | **TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING** | VOLUME - II B |
| | | SECTION - D \| SUB-SECTION – D13 |
| | | REV.NO. 00 DATE 03/10/2017 |
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# VOLUME: II B

## SECTION - D

### SUB-SECTION – D13

# SHEET WORK IN ROOF AND SIDING

## SPECIFICATION NO. PE-TS-999-600-C013

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C013 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D13<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 2 OF 6 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | SCOPE | 3 |
| 2.00.00 | INSTALLATION | 3 |
| 3.00.00 | ACCEPTANCE CRITERIA | 5 |
| 4.00.00 | I.S. CODES | 5 |
| 5.00.00 | RATES AND MEASUREMENTS | 6 |

# SHEET WORK IN ROOF AND SIDING

## 1.00.00 SCOPE

This section covers supply, cutting & fabrication and erection of corrugated/plain asbestos, corrugated galvanized iron, aluminum, permanently colour coated troughed zinc-aluminium alloy coated M.S. sheet or other sheet for covering to roof and sides at various elevations as specified.

## 2.00.00 INSTALLATION

### 2.01.00 Storage of Materials

All materials shall be stored by the Contractor in proper way to prevent all damage.

### 2.02.00 Workmanship

The workmanship shall be according to best construction practice to give a watertight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS: 2527.

### 2.02.01 Asbestos Sheeting

Asbestos sheets of profiles as specified shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification. Hook bolts or J-bolts shall be 8 mm dia. at 305 mm centres. Six (6) mm dia. galvanized iron seam bolt and nut with G.I. flat washers and bitumen washers shall be used for stiching ridge cappings, corner pieces, ventilators, north light curves etc.

### 2.02.02 C.G.I. Sheeting and Aluminium Sheeting

Side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used, the end laps shall be minimum 100 mm. Holes in C.G.I. sheets shall preferably be made on the ground. The sheets should be placed on purlins/trestles and holes punched in the ridge of the corrugation from the outside inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia. galvanised iron hooks or J-bolts and maximum spacing of the bolts shall be 305 mm. The length of the hook or J-bolts shall be to suit the sections of the bearers. Sheets shall also be bolted at the ends at every third corrugation with 6 mm dia. galvanized iron seam bolts and G.I. flat washers and bituminous washers.

## 2.02.03 Fibre Glass Reinforced Plastic Sheeting

This shall be of thickness and profile as specified. Colour and light transmittance shall be as mentioned. Where used in conjunction with C.G.I. or asbestos sheeting, the end and side laps and fixing device shall be same as used for general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure.

## 2.02.04 PERMANENT COLOUR COATED (SANDWICHED INSULATED) METAL CLADDING SYSTEM

i. Troughed zinc-aluminium alloy coated (both sides) M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150 gm/sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating ($PVF_2$) of Dry Film Thickness (DFT) 20 microns (minimum) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns.

ii. Galvanised M.S. sheets of minimum 0.6mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanization shall not be less than 275 gm/sqm.

iii. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability.

iv. Inner sheet shall be fixed directly to side runners and Z spacers made out of at least 2 mm thick galvanized steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50M centre to centre to hold the insulation and external sheeting. The fasteners shall be of high quality corrosion resistant grade of self tapping / self drilling type provided with suitable cap.

v. The insulation shall be of bonded mineral wool of minimum thickness 50mm conforming to IS:8183, having a density of 32 Kg/cum. for glass wool & 48 Kg/cum. for rock wool.

**2.02.05 PERMANENT COLOUR COATED (NON-INSULATED) METAL CLADDING SYSTEM**

i. Troughed zinc-aluminium alloy coated not less than 150 gm/sq.m M.S. sheets having 0.6 mm minimum thickness (or High tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with $PVF_2$ paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS:14246 and shall conform to class 3 for the durability.

ii. **FLASHING, CAPS, TRIM CLOSURES ETC.**

All flashings, trim closures caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding.

**3.00.00 ACCEPTANCE CRITERIA**

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

a) Side and end laps

b) Absence of cracks, holes or damages in sheet

c) Spacing of bolts

d) Provision of double washers (G.I. and asbestos or bituminous washers)

e) Proper installation of flashing.

**4.00.00 I.S. CODE**

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 3007 : Code of practice for laying of asbestos cement sheets.

IS: 2527 : Code of practice for fixing rainwater gutters and down pipes for roof drainage.

IS: 1626 : Specification for asbestos cement building pipes, gutters and fittings.

IS: 277 : Specification for galvanized steel sheets (plain and corrugated).

## 5.00.00 RATES AND MEASUREMENT

### 5.01.00 Rates

Rates shall be unit rate for complete item described in “Schedule of Items” and shall include all wastage.

### 5.02.00 Measurement

Sheeting work in roof & sides shall be measured in Sq.M. for net area of the work done. Profiled sheeting shall be measured flat and not girthed. Opening less than 0.40 Sqm shall not be deducted. No extra shall be paid for extra labour in cutting and for wastage etc. No payment shall be made for laps, flashings, sealing, fasteners etc. in sheeting works.

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C014 |
|---|---|---|
| | **TECHNICAL SPECIFICATION FOR SUSPENDED CEILING** | VOLUME - II B |
| | | SECTION - D \| SUB-SECTION – D14 |
| | | REV.NO. 00 DATE 03/10/2017 |
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# VOLUME: II B

## SECTION - D

### SUB-SECTION – D14

# SUSPENDED CEILING

## SPECIFICATION NO. PE-TS-999-600-C014

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C014 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR SUSPENDED CEILING** | VOLUME - II B |
| | | SECTION - D \| SUB-SECTION – D14 |
| | | REV.NO. 00 DATE 03/10/2017 |
| | | SHEET 2 OF 6 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
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# SUSPENDED CEILING

## 1.00.00 SCOPE

This section covers supply and installation of suspended ceiling together with the suspension system as shown on drawing or specified in schedule of item with all materials, labour and equipments. The work shall also include providing of openings in the ceiling for lighting, air-conditioning diffusers etc. as shown on drawings or as instructed by the Engineer.

## 2.00.00 INSTALLATION

### 2.01.00 Suspension System

### 2.01.01 General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural works, slabs and beams.

All members of the suspension system shall be of sufficient strength and rigidity to carry, the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown on drawings shall be securely fixed to walls. All drillings of structural concrete and installation of suitable anchoring device for installation including welding of the suspension system shall be included in the rate. All M.S. sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

### 2.01.02 Metal Grid Suspension System

Aluminium grid ceiling system shall be “Bead lock” as manufactured by W A Beard shell and Co. Pvt. Ltd. or Ajit India Limited or approved equal. Steel grid ceiling system shall be 'Jolly Snap Grid' as manufactured by Jolly Board Limited or approved equal.

Steel tees as intermediate members and steel channels, as end pieces will be assembled in the form of grid. Size of tees and channels shall be as required.

The cross-tees shall intersect main tee runners in pattern shown on drawing and positively locked together with intersection members. All perimeter areas shall have tee runners fixed to vertical wall surfaces and end channels shall be fixed to runners leaving return air space between vertical wall and channels,

unless otherwise shown on drawings. Angle cleats or other suitable fixing device shall be fixed to the structural beams above for fixing of hangers. Main runners shall be hung by M.S. flats, angles, rods or 12G or heavier galvanized tie wire hangers at maximum 1.2 metre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings. Turnbuckles shall be provided in M.S. rods for adjustment in levels.

**2.02.00 Ceiling Panels**

**2.02.01 Material**

Ceiling panels shall be best quality material in thickness and properties called for in the "Schedule of items". The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels may be of following type:

a) Plaster of Paris board (decorative)

b) Expanded polystyrene insulation board with plastic fascia.

c) Fibre Insulation board.

d) Bonded wooden particle board (Plain and decorative)

e) Glass fibre reinforced polystyrene sheets.

f) Flat asbestos sheets (with plastic fascia).

**2.02.02 Installation of Ceiling Panels**

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.

For concealed grid system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

**2.02.03 Aluminium Lineal Ceiling System**

Aluminium lineal ceiling system shall be "Luxalon 84C" or approved equal and the installation shall be strictly as per manufacturer's instruction/ specification subject to approval of the Engineer.

Aluminium lineal ceiling shall comprise of plain panels, 84 mm wide and 12.5 mm deep with a 23.9 mm recessed flange, roll formed out of 0.5 mm thick aluminium alloy panels stove enamelled on both sides, fixed on roll-formed carriers made of enamelled 0.95 mm thick aluminium, 32 mm wide and 39 mm deep with prongs to hold panels in the module of 100mm, at maximum spacing 1.2 M centre to centre. The carriers shall be suspended from roof by 4 mm dia. galvanised steel wire hangers with special height adjustment clips made out of spring steel at maximum spacing of 1.2 M c/c. Hangers shall be fixed to roof by 'J' hooks and nylon inserts. 25 mm thick resin bonded mineral wool (spintex 300 or equivalent) insulation bound in polythene shall be laid on top of panels. Lineal ceiling shall be fixed in pattern as per detailed drawings.

## 3.00.00 SAMPLES

Samples of Ceiling panels and metal suspension system components as noted below shall be submitted for Engineer's approval:

Panels : 3 samples approximately 300 mm square/long each

Suspension System : 3 samples of short length: each of main and secondary system

## 4.00.00 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval shall be obtained prior to delivery of suspended ceiling components. Shop drawings shall be co-coordinated with all related work and shall show the following information:

a) A reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.

b) Typical Intermediate framing for support where required.

c) Hanger fastening details.

d) Panels - unit support at ceiling penetrations.

e) Details of splicing method for main and cross runners.

f) A table indicating load bearing capacity of main and cross runner

g) A note stating that the suspension system member furnished will not deflect more than 1/360 of the span under the indicated loading.

## 5.00.00 ACCEPTANCE CRITERIA

Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from, sags, warps, disfigured, or damaged board. Cut-outs for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.

## 6.00.00 RATES AND MEASUREMENT

### 6.01.00 Rates

Rates shall be for the complete item called for in the “Schedule of Items”. No extra payment will be made for alignment and adjustment of lighting fixtures, air-conditioning diffusers, access panels etc. The rate shall include all cutting and wastage from standard size sheets, runners/carries etc.

### 6.02.00 Measurement

Actual area of work shall be measured in Sqm correct to second place of decimal. However, no deduction will be made for opening upto 0.25 Sqm. each in area.

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C015 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D15<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 1 OF 23 |

# VOLUME: II B

## SECTION - D

### SUB-SECTION – D15

# WATER SUPPLY, DRAINAGE AND SANITATION

## SPECIFICATION NO. PE-TS-999-600-C015

Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C015 |
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| Maharatna Company | **TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D15<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 2 OF 23 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | SCOPE | 3 |
| 2.00.00 | MATERIAL | 3 |
| 3.00.00 | INSTALLATION | 6 |
| 4.00.00 | TESTING AND ACCEPTANCE CRITERIA | 17 |
| 5.00.00 | I.S. CODES | 20 |
| 6.00.00 | RATE AND MEASUREMENT | 21 |

# WATER SUPPLY, DRAINAGE AND SANITATION

## 1.00.00 SCOPE

This section covers supply of all materials labour and incidentals required for supply, laying and installation of under/over ground pipes for water supply, drainage and sanitation with all fittings, fixtures and jointing, construction of ancillary works like manholes, drop connections, gully chambers, septic tank, soak pits, surface drain etc.

The supply and installation of water supply/sanitation fixtures and accessories like water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap container etc. with all fittings, fixtures, water supply/sanitation pipes and water storage tanks etc.

## 2.00.00 MATERIAL

All materials, fittings, fixtures, and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures, which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model, and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence orders are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets, and similar items shall be specially protected till final installation. Brass and other expansive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

### 2.01.01 Pipes and Pipe Fittings

For water supply, galvanised mild steel pipe of medium grade confirming to IS: 1239 shall be used. The galvanising shall not be less than 400gm/sqm of pipe surface area. Galvanising shall be smooth and shall be subjected to testing as per IS: 2633 for uniformity of coating. The zinc coating shall be free from defects.

For Roof drainage and building sanitation works following type of pipe are coved in this Section:

a) Cast Iron pipe

b) Steel pipe (lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanized)

c) Concrete pipe

d) Asbestos cement pipe

e) PVC pipe

f) Stoneware pipe

g) Vitrified pipe

h) Lead pipe (not to be used for portable water)

**2.02.01 Fixtures**

All material, fittings, fixtures, appliances, accessories shall be of approved quality and shall be procured from reputed brands like Hindustan/Pasriware/ Cera or equivalent or as approved by Engineer. The bidder shall procure the fixtures from the above named reputed manufacturers and shall mention in his bid the type & make of the fixtures he intends to use.

All items brought to the site must bear the manufacturer's identification mark. Procurements shall be made well in advance and should get inspected & approved immediately by the Engineer. All fixtures shall be adequately protected, covered, and plugged till handing over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The chromium plating shall be of grade-2 (10micron thickness) confirming to IS: 4827. Powder coating shall be of approved colour and shall have minimum thickness (DFT) of 20micron. Stainless steel accessories shall be of grade SS-304 and from reputed manufacturer (like Salem Steel) and shall be polished bright finish.

Unless specified in the contract the fixtures shall be as specified hereinafter.

**Water closet**

a) **European type**

It shall consist of European type glazed vitreous china basin (confirming to IS: 2556, part-II), with siphon open front solid plastic seat and plastic cover, low level glazed stoneware flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, cistern, seat and cover shall be as approved by the Engineer.

b) **Squatting type**

It shall consist of Orissa pattern glazed vitreous china squatting pan with integral foot rests (confirming to IS:2556, part-III) and high level cast iron flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The flushing cistern shall be painted as specified by the Engineer.

**Urinals**

It shall consist of wall type glazed vitreous china urinals (conforming to IS:2556), cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Frequency of automatic flushing shall be approximately once every five minutes. For every four urinals (maximum) located together may be served by one cistern of adequately capacity. All fittings shall be chromium plated.

**Wash Basin**

It shall be made of glazed vitreous china conforming to IS:2556, part-IV. The basin shall be flat back, wall hung by painted cast-iron brackets and complete with hot and cold CP brass faucets with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 32mm dia. Chromium plated brass waste of standard pattern, 32mm dia. CP brass trap union complete with necessary fittings.

**Sink**

It shall be made of glazed vitreous china conforming to IS:2556, Part-V. It shall be wall hung by painted cast iron brackets and complete with one CP brass faucet with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 40mm dia. chromium plated brass waste of standard pattern, 40mm dia. CP brass trap union complete with necessary fittings.

**Bathroom mirror**

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws, and other fittings shall be chromium plated.

**Glass shelves**

Class shelves shall consist of 6 mm thick clear glass with guardrails and shall be wall mounted with brackets. All brackets, guardrails, and screws shall be chromium plated.

**Towel rail**

Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.

**Soap holder**

It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium-plated screws.

**Liquid Soap Dispenser**

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

**Toilet roll bolder**

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screw shall be chromium plated.

**Valve, cocks, Taps**

All valves, stop cocks, taps etc. shall conform to relevant Indian standard specification and shall be of best quality from approved manufacturers. These shall be suitable for normal working pressures. Nominal size and material shall be as required / specified.

## 2.03.00 Water Storage Tank

Water storage tank shall be PVC of approved brand and make (Syntex or equivalent). Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications.

## 3.00.00 INSTALLATION

### 3.01.00 General

Basic layouts may be available in the drawings provided, the details might have to be supplemented by the Contractor and get the approval of the Engineer before installation. Special attention shall be given to economise the layout. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs, and replacements of pipes, fittings, and fixtures must be conveniently possible. All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry, and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipelines, fittings, and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

### 3.02.00 Portable water supply Pipe Lines

### 3.02.01 Laying

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level and shall run on the surface of the walls, ceiling or in chases. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. All pipes used for water supply should be thoroughly and efficiently disinfected before taken in to use.

### 3.02.02 Back Flow

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.

### 3.02.03 Contamination

There shall be no cross connection whatsoever between a pipe/fitting for conveying or containing wholesome water and a pipe/fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any other purpose. No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.

### 3.02.04 Underground Piping

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable. The size and depth of the trench shall be as approved by the Engineer. Back filling shall be done with selected fine earth, unless otherwise permitted, in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling, the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support. The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

### 3.02.05 Concealed Piping

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, and conduits as necessary. However, the Contractor will rectify if required the chases, openings, and conduits, supplement and make good after laying and testing of the concealed pipelines.

### 3.02.06 Jointing of Pipes

All G.I. pipes shall be properly thread/weld jointed and made completely water tight and durable. Burr from the joints shall be removed after screwing. Union joints shall be provided for all required location to facilitate maintenance.

### 3.02.07 Painting

Where required, underground G.I. pipes shall be given 2 coats of bituminous paint on the outside after laying. When painting is to be done above ground G.I. pipes shall be given one coat of red lead or zinc chromate primer and top coats shall be minimum 2 coats of best quality paint as specified.

## 3.03.00 RAINWATER DOWN COMERS

### 3.03.01 Pipes

Rainwater down comers shall be standard Cast Iron or Asbestos Cement Pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer.

Rainwater down comers shall run along and be secured to walls, columns etc. Where desired by the Engineer these may have to be installed in chases cut in the structure. All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type, or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

All bends and junctions shall be supplied with watertight cleanouts.

Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

### 3.03.02 Khurras

The khurras shall be constructed before the work in parapet wall is taken up and it shall be 45x45 cm in size, unless otherwise specified and shall be formed of cement concrete of M-20 grade.

### 3.03.03 Gutters

The gutters shall be made of G.I. or A.C and procured from reputed specialised manufacturers. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no sagging even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall

have on overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

## 3.04.00 SOIL AND DRAINAGE PIPES

### 3.04.01 Gradients

If not specified, the minimum gradients of soil and drainage pipeline shall be as follows:

| | | |
|---|---|---|
| 100 mm nominal dia. | : | 1 in 35 |
| 150 mm nominal dia. | : | 1 in 65 |
| 230 mm nominal dia. | : | 1 in 120 |
| 300 mm nominal dia. | : | 1 in 200 |

### 3.04.02 Relation with water supply pipelines

Unless specifically cleared by the Engineer, under no circumstances shall drainage and sewer pipes be allowed to come close to water supply pipelines.

### 3.04.03 Laying

Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

### 3.04.04 Support and Protection of Pipelines

All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be

done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.

The minimum support and protection for glazed stoneware pipes shall be as follows:

a) When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.

b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete.

c) Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched.

d) Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed of 150 mm thick cement concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

### 3.04.05 Entry into structures

For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipelines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.

### 3.04.06 Ducts

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin, or backflow.

### 3.04.07 Traps and Ventilating Pipes

Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap. Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-syphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C. I. unless desired otherwise by the Engineer.

### 3.04.08 Manhole & Inspection Chambers

At every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. However, for truck route (for pipes above 900 mm dia.) this distance can be increased to 45 M. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise provision of IS: 4111 (Part-1) shall be followed for construction of a manhole. Manhole shall be constructed so as to be watertight under test. The change in alignment shall be carried out in such a manner as to provide no lodgement for any splashing in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Unless otherwise specified, 560 mm dia. circular cast iron manhole cover with frame, heavy-duty, conforming to IS: 1726 shall be provided. The covers shall be close fittings so as to prevent gases from coming out.

### 3.04.09 Cutting of Pipes

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.

### 3.04.10 Jointing

Jointing of pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and watertight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used.

**a) Cast Iron Pipes**

Socket and spigot pipes shall be jointed by the cast lead joints. The spigot shall be centred in the socket of the pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like 'Tyton' Joints etc. shall follow the instructions of the manufactures.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leak proof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

**b) Concrete Pipes**

Jointing of concrete pipes shall be generally of rigid type. Unless otherwise stated collar type joint shall be provided. IS: 783 shall be followed for general guidance.

The two adjoining pipes shall be butted against each other and adjoined in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The angular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 sand) which shall be rammed with caulking tool. After a day’s work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured for 7 days.

**c) Glazed Stoneware Pipes**

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar 1:1 (1 cement: 1 sand). A fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. with the barrel of the pipe. The newly made joints shall be protected, until set and shall be cured by covering with damp cloth or other suitable materials.

**d) Vitrified clay pipes**

The vitrified clay pipe shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact, and glazed to make them acid resistant and impervious, and shall be obtained from approved manufacturer.

Special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen, shall be inserted in the socket of pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1), which shall have very little water. A fillet shall be formed round the joint with trowel, forming an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joints is neatly cleaned off immediately after each joint is made. A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

**e) Lead Pipes**

The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm. and 9 cm. respectively. The solders shall generally consist of two parts of lead and one part of tin.

**f) Polyethylene Pipes**

The joints shall be thermo welded or bolted as per manufacturer's instructions.

**g) Jointing Cast Iron Pipes with Stoneware Pipes**

Where any cast iron drain pipe, ventilating pipe or trap is connected with a stoneware or semi-vitrified waste pipe, the beaded spigot end of such cast iron drain pipe, waste or ventilating pipe or trap shall be inserted into a socket of such stoneware pipe and the joint made with mortar consisting of one part of cement and one part of clean sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

**h) Jointing Stoneware with Cast Iron Pipes**

Where any water closet pan or earth ware trap connected to such a pan is to be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible nature. Such joint shall be made with a mixture of bitumen and chopped asbestos fibre.

### 3.04.11 Trenches and other excavations

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimize inconvenience of traffic where applicable.

**3.04.12 Protection**

Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets, or spigot are not damaged and no foreign material can find its way into the pipeline. Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.

**3.05.00 WATER STORAGE TANKS**

Overhead/loft type water storage tank shall be made of PVC. These tanks shall be provided for each toilet block and placed on the roof/loft of the building. Tank shall be installed with proper supports and anchorage for applicable wind and seismic condition. Installation of tank shall be carried out according to the recommendation of IS: 12701. These tanks shall rest preferable on flat surface so as to distribute the load evenly. The tank shall be leak-proof and water tight.

The outlet pipe shall be 50 mm above the bottom of the tank and provided preferably with strainers. The wash out or draining pipe shall be connected at the lowest point and flush with bottom of tank.

Tank shall be provided with all fittings for inlet, outlet, overflow pipes and ball valves.

**3.06.00 SEPTIC TANK AND EFFLUENT DISPOSAL**

**3.06.01 Septic tank**

Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating

pipe of at least 100 m dia. whose top shall he provided with a suitable mosquito proof wire mesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

**3.06.02 Effluent Disposal**

The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed SW pipes laid in a trench filled with broken bricks.

**3.06.03 Soak pit**

The soak pit shall be complete. It shall consist of a 900 mm dia. pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone; brick or concrete blocks set in cement mortar (1:6) and filled with brickbats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

**3.06.04 Open joined SW Pipe/dispersion trenches**

Minimum dia. of the SW pipes shall be 150 mm nominal. The trench for laying the pipes shall be a minimum 600 x 600 mm. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well-graded coarse aggregate. Ordinary soil is used for filling the top of trench.

**3.06.05 Commissioning septic tank**

After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge, a small quantity of decaying organic matter such as digested cow-dung may be introduced.

**3.07.00 Related Works**

All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply and sanitation systems shall come under scope of the Contractor unless specifically excluded. These works are not detailed out in this Section.

**3.08.00 Regulation**

The work which is required to be carried out under this section, shall be executed by a licensed Plumber only (engaged by the Contractor) and he shall obtain all necessary sanctions, permissions, certificates etc., from Municipal and/or other Local Authorities and shall abide by all the rules of such Authorities.

**4.00.00 TESTING AND ACCEPTANCE CRITERIA**

**4.01.00 Inspection Before installation**

All pipes, fittings, and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

**4.02.00 Testing of Water Supply pipe line**

**4.02.01 Testing of Mains After Laying**

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/sq.cm or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a watertight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

**4.02.02 Testing of Service Pipes and Fittings**

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All piping, fittings, and appliances shall be checked for satisfactory support and protection from damage, corrosion, and frost.

## 4.03.00 Testing of Drain and Sewerage Pipelines

All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drainpipes laid below ground shall be tested water tight. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below:

**a) Smoke test**

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tarpaper or similar material in the combustion chamber of a smoke machine. Chemical smokes shall not be used.

**b) Water test**

The pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system, with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may be due to one or more of the following cases:

a) Absorption by pipes and joints

b) Sweating of pipes or joints

c) Leakage at joints or from defective pipes

d) Trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

**c) For straightness**

i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball with roll down the invert of the pipe end emerge at the lower end; and

ii) By means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipeline is not straight.

**4.04.00 Fittings and Fixtures etc.**

All fittings and fixtures shall be connected by water tight joints. No dripping of water shall be acceptable.

**4.05.00 Testing Septic Tank**

The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm in 24 hrs.

**5.00.00 I.S. CODES**

Important relevant IS Codes for this specification are listed below:

Latest editions shall always be consulted.

| | | |
|---|---|---|
| IS: 404 | : | Lead pipes. |
| IS: 407 | : | Brass tubes for general purposes. |
| IS: 458 | : | Concrete pipes (with or without reinforcement) |
| IS: 783 | : | Code of Practice for laying of concrete pipes. |
| IS: 1172 | : | Code of basic requirements for water supply, drainage and sanitation. |
| IS: 1200 (Pt. XVI) | : | Laying of water and sewer lines, including appurtenant items. |

| | | |
|---|---|---|
| IS: 1230 | : | Cast iron rain water pipes and fittings. |
| IS: 1239 (Pt. I & III) | : | Specification for Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter). |
| IS: 1536 | : | Specification for centrifugally cast (Spun) iron pressure pipes for water gas and sewage. |
| IS: 1537 | : | Specification for vertically cast iron pressure pipes for water, gas and sewage. |
| IS: 1592 | : | Asbestos cement pressure pipes, |
| IS: 1626 | : | Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types). |
| IS: 2065 | : | Code of Practice for Water Supply in buildings. |
| IS: 2501 | : | Copper tubes for general engineering purposes. |
| IS: 2556 | : | Specification for vitreous sanitary appliances (vitreous china) Part – I - General requirement |
| IS: 2633 | : | Method of testing, uniformity of coating on zinc coated articles. |
| IS: 3076 | : | Low density polyethylene pipes for portable water supplies. |
| IS: 3486 | : | Specification for Cast iron spigot and socket drain pipes (80 mm to 250 mm nominal diameter). |
| IS: 3589 | : | Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter). |
| IS: 4827 | : | Specification for electro plated coatings of nickel and chromium on copper and copper alloy. |
| IS: 4964 | : | High-density polyethylene pipes for portable water supplies. |
| IS: 12701 | : | Rotational moulded polyethylene water storage tanks |

## 6.00.00 RATE AND MEASUREMENT

### 6.01.00 RATE

### 6.01.01 G.I. Pipes for Water Supply

Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. with cutting, making chases and jointing of pipes, making good the walls.

### 6.01.02 Rainwater Down-comers

Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. The rate also includes cost of jointing and making good the opening in structure.

### 6.01.03 Sanitary Fixtures

Rate shall include providing and fixing of sanitary appliances & fixtures and at all elevation, including all accessories and fittings, connections pipes, waste trap and pipes all complete as per description of “Schedule of Items”. Rate shall also include the jointing of waste & traps to drain pipes.

### 6.01.04 Drainage and Sewer Pipes

Rate shall be inclusive of providing, laying and jointing of pipes as specified. Rate also include cost of lead joints or other joint as specified, cost for painting and cutting and making good walls, floors etc.

### 6.01.05 Floor and Gully Traps

Rate of traps is inclusive of all excavation, filling, repair, making good of opening in floor and walls, grating, painting etc. complete as described in “Schedule of Items”.

### 6.01.06 Manholes, Septic Tank, Soak Pit and Cover

Rate of manholes, septic tank, soak pit shall be paid under respective items of work executed like brick work, plastering, concrete, reinforcement steel etc. provided for completion of the structure as per drawing and specifications. Manhole cover shall be paid separately as per description of item.

### 6.01.07 Water Storage Tank

The rate for water storage tank is inclusive of supply and installation of tank with all fittings, inlets, outlets, valves etc. complete.

## 6.02.00 MEASUREMENTS

### 6.02.01 Pipe for Water Supply and Drainage

For G.I. Pipe of water supply line, rainwater down comers, drainage and sewer pipe, the measurements shall be in running metres and shall be taken along centre line of pipe or specials.

The pipe shall be measured separately according to dia. and class of pipe.

Fixtures like bibcock, stopcocks, valves etc. shall be measured in numbers.

### 6.02.02 Sanitary Appliances & Fixtures and Allied Works

All sanitary appliances & fixtures like sink, washbasin, WC, shall be measured in numbers for the complete work as described in schedule of items.

Floor and gully traps shall be measured in numbers unless otherwise specified.

Water storage tank shall be measured in numbers for the capacity as specified in “Schedule of Items”.

The item of work executed for completion of manholes, septic tank & soak pit shall be measured in respective items of work like brick work, RCC, plastering etc. CI cover shall be measured in numbers as specified in “Schedule of Items”.

| | TITLE: | |
|---|---|---|
| BHEL Maharatna Company | **TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE** | SPECIFICATION NO. PE-TS-999-600-C016<br>VOLUME - II B<br>SECTION - D \| SUB-SECTION – D16<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 1 OF 36 |

# VOLUME: II B

## SECTION - D

### SUB-SECTION – D16

## SPECIFICATION NO. PE-TS-999-600-C016

# ROAD AND DRAINAGE

Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C016 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE** | VOLUME - II B |
| | | SECTION - D \| SUB-SECTION – D16 |
| | | REV.NO. 00 DATE 03/10/2017 |
| | | SHEET 2 OF 36 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | SCOPE | 3 |
| 2.00.0 | CODES AND STANDARDS | 4 |
| 3.00.0 | EXECUTION | 7 |
| 4.00.00 | TESTING AND ACCEPTANCE CRITERIA | 36 |
| 5.00.00 | MEASUREMENT | 36 |

# Standard Technical Specification
## For Road and Drainage

### 1.00.00 Scope

The scope include all works required for the construction of road including construction of embankment, sub-base course, base course, tack coat, bituminous macadam, wearing course, liquid seal coat, shoulder and all incidental items of work specified or not shown but reasonably implied or necessary for the completion of the work etc.

The scope also include all works required for the construction of drainage including construction of road side drains, RCC culverts, pipe culverts, drainage pipes, manholes and all other incidental items necessary for the completion of the work etc.

### 1.01.00 Works to Be Provided by The Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

a) Construction of roads including providing all materials, labour, supervision, services, equipments, tools and plants, transportation etc. all required for the completion of the work.

b) Submission of detailed scheme of all operations required for executing the work (e.g. material handling, placement, services, approaches etc.) to the engineer for approval.

c) Carrying out tests whenever required by the engineer to assess the quality of work and submission of the test results to the engineer after completion of the same etc.

### 1.02.00 Work to Be Provided by Others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

### 1.03.00 Conformity with Designs

The contractor shall carryout the work as per the construction drawings, specification and as directed by the engineer.

**1.04.00 Materials to Be Used**

All materials required for the work shall be the best commercial variety and as approved by the engineer.

**2.00.00 Codes and Standards**

All works under this specification shall conform to the latest revision and/or replacement of the following or any other IRC/IS Codes and Standard Practices unless specified otherwise.

a) Specification for road and bridge works of Ministry of Shipping & Transport (Road Wing) Published by the IRC

b) IRC: 19 - Standard specification and code of practice for Water bound Macadam

c) IRC: SP 11 - Hand Book of Quality Control for Construction of Roads and Runways

d) IS:456 - Indian Standard Code of Practice for Plain and Reinforced Concrete.

e) IS:2212 - Code of Practice for Brick work

f) IS: 783 - Code of Practice for Laying of Concrete Pipes

g) IS: 1201 - Methods of testing tar and bituminous materials to 1220

h) IS: 73 - Specification for paving bitumen

i) IS: 215 - Specification for Road tar

j) IS: 216 - Coal tar pitch

k) IS: 217 - Specification for cut-back bitumen

l) IS: 454 - Specification for cut-back bitumen from waxy crude

m) IS: 1834 - Specification for hot applied sealing compound for joint in concrete

n) IS: 1838 - Specification for performed fillers for expansion joints in concrete, non-extruding and resilient type
Part I Bitumen impregnated fibre

Part II CNSL Aldehyde resin and coconut pith

o) IS: 334 - Glossary of terms relating to bitumen and tar

p) IS: 1077 - Common burnt clay building bricks

q) IS: 3117 - Specification for bitumen emulsion roads (anionic type)

r) IS: 1200 - Method of measurement of building and civil engineering work (Part-17)- Road work including airfield pavements

s) Other specifications mentioned elsewhere in this specification.

In case any particular aspect of work is not covered specifically by the specification/Indian Standard Code of practices, any other standard practice as may be specified by the engineer shall be followed.

## 2.01.00 Quality Control

The Contractor shall establish and maintain quality control for all materials, procedures, workmanship and equipments used. All works shall conform to the lines, grades, cross sections and dimensions shown on the drawings, specification and as directed by the engineer. Permitted tolerances for road works are described hereinafter.

### a) Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 25mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of the pavement shall be ± 40mm.

### b) Longitudinal Profile

The finished levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer and shall not exceed the tolerances as mentioned below.

Sub-grade ± 25 mm
Sub-base ± 20 mm
Base course ± 15 mm
Wearing course ± 10 mm

Tolerance in wearing course shall not be permitted in conjunction with the positive tolerance on base course if the thickness of the wearing course is thereby reduced by more than 6 mm.

**c) Surface Regularity of Sub-grade and Pavement Courses**

The surface regularity of the completed sub-base, base course and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the middle of each traffic lane along a line parallel to the center of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10m.

**TABLE –I**

**PERMITTED TOLERANCE OF SURFACE REGULARITY FOR PAVEMENT COURSES**

| Sl. No. | Type of Construction | Longitudinal profile with 3m straight edge | | | | | Cross Profile |
|---|---|---|---|---|---|---|---|
| | | Maximum permissible Undulation (mm) | Maximum number of undulations permitted in any 300m length with undulation exceeding (mm) | | | | Maximum permissible variation from specified profile under camber template (mm) |
| | | | 18 | 12 | 10 | 6 | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. | Earthen sub-grade | 25 | 30 | - | - | - | 15 |
| 2. | Granular sub-base | 15 | - | 30 | - | - | 12 |
| 3. | Water Bound Macadam with oversize metal (40-90 mm size) | 15 | - | 30 | - | - | 12 |
| 4. | Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous Penetration Macadam | 12 | - | - | 30 | - | 8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5. | Surface dressing** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam | 12 | - | - | 20 | - | 8 |
| 6. | Open graded premix carpet, mix seal Surfacing | 10 | - | - | - | 30 | 6 |
| 7. | Bituminous macadam | 10 | - | - | - | 20*** | 6 |
| 8. | Semi-dense carpet | 10 | - | - | - | 20*** | 6 |
| 9. | Asphaltic Concrete | 8 | - | - | - | 10*** | 4 |

**Notes:**

1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.

2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50 percent above these values in this column may be permitted at the discretion of the Engineer. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table.

3. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

## 3.00.00 Execution

### 3.01.00 Setting Out

Within 15 days of the award of contract, the contractor shall prepare and submit to the Engineer detailed drawings/schemes of embankment filling and excavation works as proposed to be executed by him showing the dimensions as per construction drawings and specification adding his proposals of drainage and dewatering of pits, watering and compacting the embankment fill etc. On receiving the approval from the Engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the contractor shall proceed with the work. It should be noted that this checking by the Engineer prior to the start of the work will in no way absolve the contractor of his responsibility of carrying out the work to true lines and levels as per the approved drawings. If any errors are noticed in the Contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. Profiles of the embankment made with Bamboo, earth or other convenient materials and strings shall be set up at suitable intervals for the guidance of the workmen.

## 3.02.00 Clearing and Grubbing

Before commencement of earthwork, the surface area of ground to be occupied shall be cleared of all fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below ground level or 300mm below formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the Engineer. The trees shall be cut into suitable pieces as instructed by the Engineer. Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to the approved disposal areas as may be specified. Useful materials, saleable timbers, firewood etc. shall be the property of the Owner and shall be stacked properly at the work site in a manner as directed by the Engineer.

## 3.03.00 Filling in Embankment

### 3.03.01 General

The material used for constructing the embankment shall be earth, moorum, gravel or a mixture of the above or any other material approved by the Engineer. The material shall be free from lumps and clods, boulders and rock pieces, roots and vegetation, harmful salts and chemicals, organic materials, loose silts, fine sands and expansive clays in order to provide a stable embankment. The filling and compaction operation should be such that the best available materials are saved for the top portion and will result in an acceptable and uniform gradation of material and provide impermeability and stability to the embankment when compacted. The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm. However, the Engineer may at his discretion permit the use of material coarser than the specified if he is satisfied that the same will not present any difficulty as regard to the placement and compaction of the fill material are concerned. Ordinarily, only the materials satisfying the density requirements as given below in Table-II shall be employed for embankment construction.

**Table - II**

**Density Requirements of Embankment Materials**

| Sl. No. | Type of Work | Maximum laboratory dry density when tested as per IS: 2720 (Part - VII) |
|---|---|---|
| 1. | Embankment upto 3m height | Not less than 1.44 gm/cc |
| 2. | Embankment exceeding 3m height and embankment of any height subject to long period of inundation | Not less than 1.52 gm/cc |
| 3. | Top 0.5m of the embankment below sub-base and shoulders (where earth shoulders are specified) | Not less than 1.65 gm/cc |

Expansive clays exhibiting marked swell and shrinkage properties shall not be used for embankment construction.

The material for embankment construction shall be obtained from approved sources with preference given to the materials available from nearby road excavation or any other excavation under the same contract.

**3.03.02 Setting Out**

After the site clearance, the work shall be set out true to lines, curves, slopes, grades and sections as shown on the approved drawings or as directed by the Engineer. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboo, stones, lime, mortar, concrete etc. required in connection with the setting out of the works and establishment of the bench marks. The limits of the embankment shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. To ensure the safety, the pegs should normally be fixed about 500mm away from the actual limits of the fill and to be painted in a distinct colour. The centreline of the embankment shall be pegged at regular intervals of 25/30m and at all skews/curves. The actual profile of the embankment shall be made at every third centre line peg with bamboo posts and strings. Preferably prototype profiles developed with wooden planks need to be fixed at every 200m and at the intersection points at curves. The profile shall be about 3m long.

### 3.03.03 Stripping and Storing top soil

The construction of the earthen embankment by filling shall conform to the dimensions, slopes and other details shown in the approved drawings. Before commencement of the embankment construction, the surface area of ground to be occupied after clearing and grubbing shall be stripped off to a minimum depth of 150mm or more as directed by the Engineer in order to remove all perishable materials and any soil which may become unstable on saturation or may interfere with the development or proper bonding between the foundation and embankment. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. In localities where most of the available embankment fill materials are not conducive to plant growth or when so directed by the Engineer, the top soil suitable for plant growth existing over the embankment foundation areas shall be stripped to specified depths not exceeding 150mm and stored for covering the embankment slopes where revegetation is desired.

### 3.03.04 Compacting Original Ground

In all cases, the original ground after stripping shall be compacted by rolling with a minimum six passes of 8-10 tons' roller and as directed by the Engineer.

Where the height of the proposed embankment is less than 0.5m and the original ground does not already have a relative compaction of atleast 95 percent of Standard Proctor density (maximum dry density), the same shall be loosened upto a depth of 0.5m and filled in layers not exceeding 250mm in loose thickness and each layer shall be watered and compacted to 100% maximum dry density of the fill material determined in accordance with IS:2720, Part-VII. However before relaying and compacting the loosened material, the surface below this level shall be suitably compacted as directed by the Engineer with a minimum six passes of 8 - 10 tonne roller.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced with approved materials suitably compacted. Embankment work shall not proceed until the foundation soil of the embankment is inspected by the Engineer and approved.

### 3.03.05 Filling

The embankment material shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder. Moisture content of the fill material shall be checked at the source of supply and if found less than that specified for compaction, the same shall

be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case water shall be sprinkled directly from a hose line or from a truck mounted water tank and flooding shall not be permitted under any circumstances. After adding required amount of water, the soil shall be processed by means of harrows, rotary mixers or by any other approved method until the layer is uniformly wet.

If the material delivered to the road bed is too wet, it shall be dried by aeration and exposure to the sun till the moisture content is acceptable for compaction. Should circumstances arise where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended.

Moisture content of each layer shall be checked in accordance with IS:2720, Part-II and unless otherwise specified shall be so maintained making due allowance for evaporation losses that during compaction, the moisture content shall be in the range of 1 percent above to 2 percent below the optimum moisture content as determined in accordance with IS:2720, Part-VII.

Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5m portion of the embankment below sub-base.

Hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer to minimise rutting or uneven compaction.

Where the embankment is to be constructed across a low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer to a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

### 3.03.06 Compaction

Compaction equipment approved by the Engineer shall only be employed for construction. If directed by the Engineer, the Contractor shall demonstrate the efficiency of the plant he intends to use by carrying out compaction trials.
Each layer shall be thoroughly compacted to the density as specified in Table-III. Subsequent layers shall be placed only after the finished layer has been tested and accepted by the Engineer.

**Table - III**

**Compaction Requirements for Embankment**

| Sl. No. | Type of work/material | Field dry density as a percentage of maximum laboratory dry density as per IS: 2720, Part-VII |
|---|---|---|
| 1. | Top 0.5m portion of embankment below sub-base and shoulders | Not less than 100 |
| 2. | Other portions of embankment | Not less than 95 |

When density measurements reveal any soft area in the embankment, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft area shall be removed and replaced with approved material and compacted to the density requirements and satisfaction of the Engineer.

**3.03.07 Drainage**

The surface of the embankment at all times during construction shall be maintained at such a cross fall as will shed water and prevent ponding.

**3.03.08 Finishing Operations**

Finishing operations shall include the work of shaping and dressing the shoulders, road bed and side slopes to conform the alignment, levels, cross sections and dimensions as shown on the drawings or as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve the appearance and merge the embankment with the adjacent terrain.

**3.04.00 Turfing with Sods**

**3.04.01 General**

This work shall consist of furnishing and laying live sod of perennial turf forming grass on embankment slopes, shoulders or other locations as shown on the drawings or as directed by the Engineer. Unless otherwise specified the work shall be taken up following the construction of embankment provided the season is favourable for establishment of the sod.

**3.04.02 Materials**

The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically

free from weeds and other undesirable matters. At the time the sod is cut, the grass shall have a length of approximately 50mm and the sod shall be free from any debris.

Thickness of the sod shall be as uniform as possible with about 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that practically all the dense root system of the grass is retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than 250mm x 300mm in size but not so large so that it is convenient to handle and transport without damage. During wet weather the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather it shall be watered before lifting to ensure its vitality and to prevent dropping of soil during handling.

### 3.04.03 Placing The Sods

The area to be sodded shall be previously constructed to the required slope and cross section. Soil in the area shall be loosened, freed from all stones larger than 50mm size, sticks, stumps and any other undesirable foreign matters etc. and brought to a reasonably granular texture to a depth not less than 25mm for receiving the sod.

Where required, top soil shall be spread over the slopes. Prior to placing the top soil, the slopes shall be roughened and wetted in order to have a satisfactory bond. The depth of top soil (to be spread) shall be 75mm.

Following soil preparation and top soiling (if required), fertilizer and ground limestone when specified shall be spread uniformly. After spreading, the materials shall be incorporated in the soil by discing or other means. The prepared sod bed shall be moistened if not already sufficiently moist and the sod shall be placed thereon within 24 hours after the same has been cut. Each sod strip shall be laid in close contact with each other and shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil. At points where water may flow over the sod, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth shall be placed over it followed by thorough compaction.

### 3.04.04 Staking the Sods

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000mm along the longitudinal axis of the sod strips. Stakes shall be driven approximately plumb through the sods and to be almost flushed with them.

### 3.04.05 Top Dressing

After the sods have been laid in position, the surface shall be cleaned of any loose sod, excess soil and other foreign materials. Thereafter a thin layer of top soil shall be scattered over the top dressed surface and the area shall be thoroughly moistened by sprinkling water.

### 3.04.06 Watering and Maintenance

The turfing so laid shall be well watered and protected until final acceptance. Watering shall be done in such a way that no erosion or damage to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the sods which are failing to show uniform growth of grass or damaged by his operation and shall maintain the sod at his own cost until final acceptance.

## 3.05.00 Shoulder Construction

### 3.05.01 Description

This work shall consist of constructing shoulder on either side of the pavement in accordance with the requirements of this specification and in conformity with the lines, grades and cross sections shown on the approved drawings and as directed by the Engineer.

### 3.05.02 Materials

Shoulder shall be made of selected earth or granular material as specified conforming to relevant IRC standards.

### 3.05.03 Construction Operations

Except in the case of bituminous pavements, the shoulders shall be constructed in advance to the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and the area enclosed between the shoulders shall be cleaned of all spilled materials before proceeding with the construction of the pavement layer.

In the case of bituminous pavements, shoulder shall be constructed only after the pavement courses have been laid and compacted.

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed without any damage to the

pavement and the area so affected shall be thoroughly cleaned. During all stages of shoulder construction, the required cross fall shall be maintained to drain off surface water.

**3.06.00 Kerb**

**3.06.01 Material**

Kerb if required for the construction of footpath shall consist of precast concrete blocks with concrete grade of M-20. The blocks shall be of 100mm thick and of suitable length. The depth of blocks unless otherwise mentioned elsewhere shall be 375mm considering 225mm height of footpath above the road level.

**3.06.02 Laying**

The kerb shall be laid by cutting trenches of 150mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the kerbs shall be in plumb and the gap between the block shall not be more than 10mm.The gap shall be filled with cement mortar as specified.

The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer.

**3.07.00 Sub-base (Granular Sub-base)**

**3.07.01 Description**

This work shall consist of laying and compacting well graded material on the prepared sub-grade in accordance with the specification. The material shall be laid in one or more layers as shown on the drawings and shall conform to the lines, grades and cross sections shown on the drawings and as directed by the Engineer.

**3.07.02 Materials**

The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kankar etc or combinations thereof depending upon the grading required. The mixed materials shall be free from organic and other deleterious constituents and conform to one of the three grading given in Table - IV below.

**Table - IV**
**Grading for Granular Sub-Base Material**

| Sieve designation | Percent by weight passing the sieve | | |
|---|---|---|---|
| | Grading 1 | Grading 2 | Grading 3 |
| 80 mm<br>63 mm<br>4.75 mm<br>75 micron | 100<br>90 - 100<br>35 - 70<br>0 - 20 | 100<br>90 - 100<br>40 - 90<br>0 - 25 | 100<br>90 - 100<br>50 - 100<br>0 - 30 |
| Minimum CBR value for the fraction of material passing 20 mm sieve. | 30 % | 25% | 20% |

**Note:** The materials passing 425micron sieve for all the three gradings when tested according to IS: 2720, Part V shall have liquid limit and plasticity index not more than 25 percent and 6 percent respectively.

### 3.07.03 Physical Requirements

The fraction of materials passing 20mm sieve shall give a CBR value as specified in Table – IV when tested in accordance with IS: 2720, Part XVI after preparing the samples at maximum dry density and optimum moisture content corresponding to IS: 2720, Part VII and soaking the same in water for 4 days.

### 3.07.04 Spreading and Compacting

Immediately prior to laying of sub-base, the sub-grade already finished shall be prepared by removing all vegetation’s and other extraneous matters, lightly sprinkled with water if necessary and rolled with one pass of 8 - 10 tonne smooth wheeled roller.

The sub-base material shall be spread on the sub-grade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of each layer after compaction shall not exceed 150mm.

Moisture content of the loose material shall be checked in accordance with IS: 2720, Part II and shall be suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it shall be from 1 percent above to 2 percent below the optimum moisture content. While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet.

Immediately thereafter, rolling shall be done with 8 to 10 tonne smooth wheeled rollers or with any other approved plant. Rolling shall commence from the edges and progress towards the centre longitudinally except on super elevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and camber shall be checked and any high spots or depressions which become apparent shall be corrected by removing or adding fresh material.

Rolling shall be continued till the density achieved is at least 100% of the maximum dry density of the material determined as per IS: 2720, Part VII. The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose materials. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and recompacted.

## 3.08.00 Water Bound Macadam Sub-base/Base Course

### 3.08.01 Description

Water bound macadam shall consist of clean crushed aggregates mechanically interlocked by rolling and bonded together with screenings, binding material wherever necessary and water, laid on the prepared sub-grade or sub-base as the case may be and finished in accordance with the specification and in conformity with the lines, grades and cross-sections shown on the approved drawings.

### 3.08.02 Materials

**a) Coarse Aggregates - General Requirements**

Coarse aggregates shall be either crushed or broken stone. The aggregates shall conform to the physical requirements set forth in Table - V.

**Table – V**

**Physical Requirements of Coarse Aggregates for Water Bound Macadam**

| S.No. | Type of Construction | Test | **Test method** | Requirements |
|---|---|---|---|---|
| 1. | Sub-base | Los Angeles Abrasion Value * | IS: 2386 (Part IV) | 50 percent maximum |
| | | or | | |
| | | Aggregate Impact Value | IS: 2386 (Part IV) | 40 percent maximum |
| | | | or | |
| | | | IS: 5640** | |
| 2. | Base | a) Loss Angeles Abrasion value* | IS: 2386 (Part IV) | 50 percent maximum |
| | | or | | |
| | | Aggregate Impact Value | IS: 2386 (Part IV) | 40 percent maximum |
| | | | or | |
| | | | IS: 5640 ** | |
| | | b) Flakiness Index *** | IS: 2386 (Part I) | 15 percent maximum |

* Aggregates shall satisfy requirements of either of the two tests.

** Aggregates like brick metal, kankar and laterite which get softened in presence of water shall be tested for impact value under conditions in accordance with IS: 5640.

*** The requirements of Flakiness Index shall be enforced only in case of crushed or broken stone and crushed slag.

**b) Crushed or Broken Stone**

Crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other objectionable matters.

**c) Grading Requirements of Coarse Aggregates**

The coarse aggregates shall conform to one of the gradings given in Table – VI. However, the use of Grading-1 shall be restricted to sub-base courses only.

**Table - VI**
**Grading Requirements of Coarse Aggregates**

| Grading | Size range | Sieve designation | Percent by weight passing the sieve |
|---|---|---|---|
| 1. | 90mm to 40 mm | 100 mm<br>80 mm<br>63 mm<br>40 mm<br>20 mm | 100<br>65 - 85<br>25 - 60<br>0 - 15<br>0 - 5 |
| 2. | 63 mm to 40 mm | 80 mm<br>63 mm<br>50 mm<br>40 mm<br>20 mm | 100<br>90 - 100<br>35 - 70<br>0 - 15<br>0 - 5 |
| 3. | 50 mm to 20 mm | 63 mm<br>50 mm<br>40 mm<br>20 mm<br>10 mm | 100<br>95 - 100<br>35 - 70<br>0 - 10<br>0 - 5 |

**d) Screenings**

Screenings to fill the voids in the coarse aggregate shall generally consist of the same material as the coarse aggregates. However, where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75-micron sieve does not exceed 10 percent.

As far as possible, screenings shall conform to the grading set forth in Table-VII. Screenings of Type-A in Table-VII shall be used with coarse aggregates of Grading-1 in Table-VI. Screenings of Type-A or B shall be used with coarse aggregates of Grading-2. Screenings of Type-B shall be used with coarse aggregates of Grading-3.

**Table - VII**
**Grading for Screenings**

| Grading classification | Size of screenings | Sieve designation | Percent by weight passing the sieve |
|---|---|---|---|
| A | 12.5 mm | 12.5 mm<br>10.0 mm<br>4.75 mm<br>150 micron | 100<br>90 - 100<br>10 - 30<br>0 - 8 |
| B | 10 mm | 10 mm<br>4.75 mm<br>150 micron | 100<br>85 - 100<br>10 - 30 |

**e) Binding Material**

Binding material to be used for water bound macadam construction shall comprise of a suitable material approved by the Engineer having plasticity index value less than 6 as determined in accordance with IS: 2720, Part V. Application of binding material may not be necessary when the screenings used are of crushable type such as moorum or gravel.

**3.08.03 Construction Operations**

a) The sub-grade/sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of any dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid over an existing black topped surface, 50mm x 50mm furrows shall be cut at an angle of 45 degrees to the center line of the road at 1m intervals in the latter before laying the coarse aggregates.

**b) Inverted Choke**

If water bound macadam is to be laid directly over the sub-grade without any other intervening pavement course, a 25mm course of screenings (Grading-B) shall be spread on the prepared sub-grade before application of coarse aggregates is taken up.

**c) Spreading Coarse Aggregates**

The coarse aggregates shall be spread uniformly over the prepared surface in such quantities that the thickness of each compacted layer is limited to 100mm for Grading-1 and 75 - 100mm for Grading-2 and 3. The spreading shall be

done from stockpiles along the side of the roadway or directly from the vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregates as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operation.

**d) Rolling**

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or with tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road. Each pass of the roller shall uniformly overlap not less than one half the width of the track made in the preceding pass.

Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities found shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and rerolled until the entire surface conform to the desired camber and grade. In no case shall the use of screenings be permitted to make up the depressions.

**e) Application of Screenings**

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreader or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregates.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms or hand brooms or with both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregates.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of road which could be completed within one day's operation.

**f) Sprinkling and Grouting**

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregates are thoroughly keyed, well bonded and firmly set to its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excess quantity of water during construction.

**g) Application of Binding Material**

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water and the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling the voids form a wave ahead of the wheels of the moving roller.

**h) Setting and Drying**

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam is set. The Engineer shall have the discretion to stop hauling traffic from using the complete water bound macadam course if in his opinion it would cause excessive damage to the surface.

## 3.09.00 Tack Coat

### 3.09.01 Description

The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction.

### 3.09.02 Materials

The binder used for tack coat shall be bitumen of a suitable grade as approved by the Engineer and conforming to IS-73, IS-217 or IS-454 as applicable or any other approved cutback.

### 3.09.03 Construction Operations

**a) Preparation of Base**

The surface on which the tack coat is to be applied shall be thoroughly swept and scraped clean of dust and any other extraneous materials before the application of the binder.

**b) Application of Binder**

Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified below. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be supplied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

## 3.10.00 Bituminous Macadam Binder Course

### 3.10.01 Description

This work shall consist of construction in a single course of 50mm/75mm thickness of compacted crushed aggregates premixed with a bituminous binder laid immediately after mixing on a base prepared previously in accordance with the specification and in conformity with the lines, grades and cross sections shown on the approved drawings.

**3.10.02 Materials**

**a) Binder**

The Binder shall be straight run bitumen of a suitable grade as directed by the Engineer complying with IS: 73.

**b) Aggregates**

The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable, fairly cubical in shape and free from any disintegrated pieces, organic and other deleterious matter and adherent coats. The aggregates shall preferably be hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set forth in Table - VIII.

**Table – VIII**

**Physical Requirements of Aggregates for Bituminous Macadam**

| Sl. No. | Test | Test method | Requirements |
|---|---|---|---|
| 1. | Los Angeles Abrasion Value * | IS: 2386 (Part IV) | 35 percent maximum |
| 2. | Aggregate Impact Value * | IS: 2386 (Part IV) | 30 percent maximum |
| 3. | Flakiness Index | IS: 2386 (Part I) | 35 percent maximum |
| 4. | Stripping Value | IS: 6241 (Part IV) | 25 percent maximum |
| 5. | Water Absorption | IS: 2386 (Part III) | 2 percent maximum |

*Aggregates may satisfy requirements of either of the two tests.

The aggregates for bituminous macadam for different thickness shall conform to Grading- A or B as given in Table-IX or X as the case may be.

**Table-IX**
**Aggregates Grading for 75mm Compacted Thickness of Bituminous Macadam**

| Sieve Designation | Percent by weight passing the sieve | |
|---|---|---|
| | Grading A | Grading B |
| 63 mm | 100 | |
| 50 mm | 90 - 100 | |
| 40 mm | 35 - 65 | 100 |
| 25 mm | 20 - 40 | 70 - 100 |
| 20 mm | - | 50 - 80 |
| 12.5 mm | 5 - 20 | - |
| 4.75 mm | - | 10 - 30 |
| 2.36 mm | - | 5 - 20 |
| 75 micron | 0 - 5 | 0 - 4 |

**Table-X**
**Aggregates Grading for 50mm Compacted Thickness of Bituminous Macadam**

| Sieve Designation | Percent by weight passing the sieve | |
|---|---|---|
| | Grading A | Grading B |
| 50 mm | 100 | |
| 40 mm | 90 - 100 | |
| 25 mm | 50 - 80 | 100 |
| 20 mm | - | 70 -100 |
| 12.5 mm | 10 - 30 | - |
| 10 mm | - | 35 - 60 |
| 4.75 mm | - | 15 - 35 |
| 2.36 mm | - | 5 - 20 |
| 75 micron | 0 - 5 | 0 - 4 |

**c) Proportioning of Materials**

The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate Grading-A and B respectively unless directed otherwise by the Engineer. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

**d) Variation in Proportioning of Materials**

The Contractor shall have the responsibility for ensuring proper proportion of materials and producing a uniform mix. A variation in binder content upto ± 0.3 percent by weight of total mix shall however be permissible for individual specimens taken for quality control tests.

**3.10.03 Construction Operations**

**a) Weather and Seasonal Limitations**

Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet.

**b) Preparation of Base**

The base on which the bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross sections as shown on the drawings and as directed by the Engineer. The surface shall be thoroughly swept and scraped clean and free of any dust and foreign matter.

**c) Tack Coat**

A tack coat shall be applied over the base.

**d) Preparation and Transport of Mix**

Hot mix plant of adequate capacity shall be used for preparing the mix. The temperature of binder at the time of mixing shall be in the range 150 Deg. - 165 Deg. C and to that of aggregates shall be in the range 125 Deg. - 150 Deg. C provided the temperature difference between the binder and the aggregate at no time exceeds 25 Deg. C. Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly. The mixture shall be transported from the mixing plant to the point of use in a suitable vehicle. The vehicle employed for transport shall be clean and be covered over in transit if so directed by the Engineer.

**e) Spreading**

After mixing, the mix shall be spread immediately by means of a self-propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to the specified lines, grade and cross sections. However, in restricted locations and in narrow widths where the available plants cannot operate in the opinion of the Engineer may permit manual laying of the mix. The temperature of mix at the time of laying shall be in the range 110 Deg. - 135 Deg. C.

In multilayer construction, the longitudinal joint in one layer shall offset into the layer below by about 150mm. However, the joint in the topmost layer shall be at the centre line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

**f) Rolling**

After spreading of mix, the rolling shall be done with 8 to 10 tons' power roller or with any other approved plant. Rolling should start as soon as the materials are spread. Rolling shall be done with care to avoid any undulation in the pavement surface.

Rolling on the longitudinal joint shall be done immediately after the paving operation. After this, the rolling shall commence at the edges and progress towards the center longitudinally except on superelevated portions where it shall progress from the lower to the upper edge parallel to the center line of the pavement.

The initial or breakdown rolling shall be done as soon as it is possible to roll the mixture without cracking the surface and no mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling as early as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while the material is still workable enough for removal of roller marks.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh materials. The rolling shall then be continued till the entire surface has been rolled to compaction and there is no crushing of aggregates and till all the roller marks are eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking on the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose.

Rolling operation shall be completed in every respect before the temperature of the mix fall below 80 Deg. C.

Rollers shall not stand on the newly laid material as it may lead to undue deformation. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh

surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

The bituminous macadam shall be provided with a final surfacing without any delay. If there is to be any delay the course shall be covered by seal coat before allowing any traffic over it.

## 3.11.00 Open Graded Premix Carpet

### 3.11.01 Description

This work shall consist of laying and compacting open graded carpet of specified thickness in a single course of suitable small sized aggregates premixed with bituminous binder on a previously prepared base to form wearing course in accordance with the specification.

### 3.11.02 Materials

**a) Binder**

The binder shall be bitumen of suitable grade as approved by the Engineer and satisfying the requirements of IS: 73, 217, 454 or any other approved cutback as applicable.

**b) Aggregates**

The aggregates shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingle and be free of elongated and flaky pieces, soft and disintegrated materials, vegetable and any other deleterious matter etc. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirements set forth in Table-VIII except that the flakiness Index shall be limited to a maximum of 30.

**c) Proportioning of Materials**

The materials shall be proportioned as per the quantities given in Table-XI for 20mm thick open graded premix carpet.

**Table - XI**

**Quantity of Materials Required for 10 Sq. M of Road Surface for 20mm Thick Open Graded Premix Carpet**

| | | |
|---|---|---|
| | Aggregates for Carpet | |
| i) | Stone Chippings - 12mm size; passing 20 mm sieve and retained on 10 mm sieve | 0.18 Cu.m |
| ii) | Stone Chippings - 10 mm size; passing 12.5 mm sieve and retained on 6.3 mm sieve | 0.09 Cu.m |
| | Total | 0. 27 Cu.m |
| | Binder for premixing (quantities in terms of straight run bitumen) | |
| i) | For 0. 18 Cu.m of 12 mm size stone Chippings at 52 Kg per Cu.m | 9.5 Kg |
| ii) | For 0.09 Cu. M of 10mm size stone Chippings at 56 Kg per Cu.m | 5.1 Kg |
| | Total | 14.6 Kg |

**3.11.03 Construction Operation**

**a) Weather and Seasonal Limitations**

Open graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg. C or below.

**b) Preparation of Base**

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with the drawing, specification and as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matters with wire brushes, sweeping with brooms and finally dusting with sacks as necessary.

**c) Tack Coat**

A tack coat complying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. However, application of tack coat shall not be necessary when the laying of carpet follows soon after laying the bituminous course.

**d) Preparation of Premix**

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed.

**e) Spreading and Rolling**

The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material is laid, rolling shall be commenced with 6 to 8 tons' power rollers preferably with smooth wheel tandem type or with any other approved plant. Rolling shall begin at the edges and progress toward the center longitudinally except on the superelevated portions where it shall progress from the lower to upper edge parallel to the center line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks have been eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material as it may lead to undue deformations.

The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted

with a thin surface coat of approved binder before the new mix is placed against it.

**f) Seal Coat**

A seal coat conforming to clause 3.12.00 shall be applied to the surface immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed.

## 3.12.00 Seal Coat

### 3.12.01 Description

This work shall consist of application of a seal coat as specified for sealing the voids in the bituminous surface laid to the specified levels, grade and camber.

**Type-A:** Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chippings.

**Type-B:** Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

### 3.12.02 Materials

**a) Binder**

The binder shall be bitumen of suitable grade as directed by the Engineer and conforming to the requirements of IS: 73, 217 or 454 as applicable or any other approved cutback.

The quantity of binder to be adopted in terms of straight run bitumen shall be 9.8 Kg and 6.8 Kg per 10 square metre area for Type-A and Type-B seal coat respectively.

**b) Stone Chippings for Type a Seal Coat**

The stone chippings shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matters etc. Stone chippings shall be of 6mm size defined as 100 percent passing through 10mm sieve and retained on 2.36mm sieve. The quantity used for spreading shall be 0.09 cu.m. per 10 sq.m area. The chippings shall satisfy the quality requirements spelled out in Table- VIII except that the upper limit for flakiness Index shall be 30.

**c) Fine Aggregate for Type B Seal Coat**

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180-micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area.

## 3.12.03 Construction Operations

**a) Preparation of Base**

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat, the surface shall be cleaned free of any dust or other extraneous matters.

**b) Construction of Type-A Seal Coat**

The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer or through leakage or due to any other reason shall be suitably corrected before the stone chippings are spread.

Immediately after the application of binder, stone chippings in a dry and clean state shall be spread uniformly on the surface preferably by means of a mechanical grittier or otherwise manually so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8 - 10 tonne smooth wheeled roller. Rolling shall commence from the edges and progress towards the centre except in superelevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up the irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present a uniform closed surface.

**c) Construction of Type-B Seal Coat**

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer. Also the aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before the same are placed in the mixer. Mixing of

binder with aggregates to the specified proportions shall be continued till the latter is thoroughly coated with the former. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 6 - 8 tonne smooth wheeled power rollers. Rolling shall be continued till the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

### 3.12.04 Opening to Traffic

In case of Type-B Seal coat, traffic may be allowed soon after the final rolling when the premixed materials are cooled down to the surrounding temperature. However, in case of Type- A seal coat, the traffic shall not be permitted until the following day.

### 3.13.00 Repair of Existing Water Bound Macadam Surfaces

Pot holes or patches and ruts in the water bound macadam base or surface course which is to be surface treated shall be repaired by removing all loose materials by cutting in rectangular patches and replacing with suitable materials. The repair shall be done as under.

Pot holes, patches and ruts shall be drained of any water and cut to regular shape with vertical sides and then be filled either with i) coarse aggregates and screenings conforming to the specification for water bound macadam and compacted with rollers or other approved rammer etc. or with ii) premixed material conforming to the specification for open graded premix carpet and compacted with rollers or other approved means after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both as directed by the Engineer.

### 3.14.00 Road Side Drains

### 3.14.01 Drains

The road side drains shall be made in sizes and slopes as shown on the approved drawings. The sides and bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts outside the plant area as per the drawings and instructions of the Engineer.

The excavated spoils other than that required for backfilling shall be transported and filled in low areas within the plant area or in embankments as instructed by the Engineer. The lining for drains shall be as per the drawings. Lining of drains may be of bricks or cement concrete blocks of specified grade as shown on the approved drawing or as directed by the Engineer. If shown

on approved drawing, drains shall be of R.C.C. construction with necessary slopes.

### 3.15.00 Culverts

Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the drawings and instructions of the Engineer after clearing the site etc. As described in the "Specification for Earthwork in Excavation and Backfilling", backfilling in layers with watering and compaction shall be done after the construction of foundations. The construction of culverts shall be done true to the lines and levels as shown on the drawings. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed as applicable.

### 3.16.00 Pipe Culverts and Drainage Pipes

### 3.16.01 Materials

The drainage pipes shall be made of R.C.C and shall be either class NP-2 or NP-3 as shown on the approved drawings. Pipe culverts shall be made of reinforced concrete pipe and shall be of class NP4 or RDSO class for railways as shown in the drawing. All pipes shall meet the requirements of IS: 458 and shall be procured from approved manufacturers with collars as per manufacturer's specification. The tenderer shall specifically mention the particular manufacturer's product he proposes to use.

Cement shall be ordinary Portland Cement as per IS:269. Coarse Aggregates shall be as per IS:383. Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. Fine aggregates for concrete shall be as per IS:383.

### 3.16.02 Laying of Pipes

Laying of concrete pipes shall correspond to IS:783 and as per the specification given below.

a) The foundation bed for pipe shall be excavated true to lines and grades shown on the drawings and as directed by the Engineer. When trenching is involved, its width on either side of the pipe shall not be less than 150mm and not more than one third the diameter of pipe unless otherwise instructed/permitted by the Engineer. The sides of the trench shall be as nearly vertical as possible. Side slope, shoring, bailing out water etc. as required shall be done by the Contractor.

Side slips if there be any shall be removed by the Contractor. After laying of the pipes are completed, backfilling of the trenches shall be done as per "Specification for Earthwork in Excavation and Backfilling" to the

satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area as instructed by the Engineer.

When bedrock or boulder stratum is encountered during excavation, the excavation shall be taken down to at least 200mm below the bottom of the pipe with prior permission of the Engineer and all rock/boulders in the area shall be removed and space filled with approved earth free from stone or fragmented materials, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Filling of trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur and shall be done as per the “Specification for Earthwork in Excavation and Backfilling”. When two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care to avoid any damage. Under no circumstances the pipes shall be dropped into the trench or on supports from heights.

b) Pipe bedding shall be first class projection bedding for positive projecting pipes as per IS: 783 having a projection ratio not greater than 0.70. The pipe shall be carefully laid on bedding made up of fine granular materials in an earth foundation; the bedding shall be carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height and in which the fill material is thoroughly compacted in layers not exceeding 150mm in depth around the pipe for the remainder of the pipe laid in trench.

When indicated on the drawings or directed by the Engineer, the pipe shall be bedded on a cradle constructed of concrete having a mix not leaner than M-15. The shape and dimension of the cradle shall be as indicated on the drawing or as directed by the Engineer. The pipe shall be laid on the concrete bedding before the concrete is set.

c) The drop walls shall be made with first class brickwork in 1:4 cement mortar.

d) The pipe culverts shall be made with proper care with respect to the invert of the pipe, gradient if any etc. as specified on the drawings and as instructed by the Engineer.

e) Where R.C.C pipes are encased in concrete at road crossings or at other places the pipes need be suitably supported avoiding reinforcements of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block may be done in a single operation or may be done upto some height for pipes to be properly laid in position and the balance height of the block shall be concreted subsequently.

f) The R.C.C. pipes shall be joined with cement mortar. Cement mortar shall consist of 1 part of cement and 2 part of clean sand with only enough water for workability. Procedure of jointing shall be as per IS: 783.

**3.16.03 Relation with Water Supply Pipeline**

Unless specifically cleared by the Engineer, under no circumstances shall the drainage pipes be allowed to come close to water supply pipelines.

**3.17.00 Manholes and Inspection Chambers**

The maximum distance between the manholes shall be 30m unless specifically permitted otherwise. In addition, at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance between the manhole or inspection chamber and gully chamber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide a smooth flow. Connection to the existing pipelines shall be through a manhole. Manholes shall be provided with standard covers usually of C.I. or as directed by the Engineer. The cover shall be closely fitted so as to prevent gases from coming out.

**4.00.00 Testing and Acceptance Criteria**

All testing as mentioned in the specification and as mentioned in Clause No. 900 of the “Specification for Roads and Bridge Works, 1983” published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Contractor as per the direction of the Engineer.

**5.00.00 MEASUREMENT**

Method of measurement shall be as per the latest version of IS:1200, Part-17 and as directed by the Engineer.

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C017 |
|---|---|---|
| | **TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK** | VOLUME - II B |
| | | SECTION - D SUBSECTION -D17 |
| | | REV.NO. 0 DATE 03/10/2017 |
| | | SHEET 1 OF 41 |

# VOLUME: II B

## SECTION - D
## (PART I)

## SUB-SECTION – D 17

## FABRICATION OF STRUCTURAL STEEL WORK

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C017 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK** | VOLUME - II B<br>SECTION - D SUBSECTION -D17<br>REV.NO. 0 DATE 03/10/2017<br>SHEET 2 OF 41 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | SCOPE | 3 |
| 2.00.00 | GENERAL | 3 |
| 3.00.00 | WORKMANSHIP | 19 |
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| 6.00.00 | RATES AND MEASUREMENTS | 34 |

# SUB-SECTION – D XVII

## FABRICATION OF STRUCTURAL STEEL WORK

### 1.00.00 SCOPE

This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets, bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract.

### 2.00.00 GENERAL

### 2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following

a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As decided by the Engineer, some or all of these detailed drawings will have to be submitted for approval.

b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.

c) To submit design calculations for joints and. connections developed by the contractor along with detailed fabrication drawings.

d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary rivets, bolts, nuts, washers, tie rods and welding electrodes for field connections,

e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.

f) Suitably mark, bundle, and pack for transport all fabricated materials.

g) Prepare and furnish detailed Bill of Materials, Drawing Office Dispatch lists, Rivet and Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.

h) Insure, load and transport all fabricated steelwork field connection materials to site.

i) Maintain a fully equipped workshop at site for fabrication, modification and repairs of steelwork at site as may be required to complete the works in accordance with the Contract.

**2.02.00 Work by others**

No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.

**2.03.00 Codes and standards**

All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard specification, any other standard practice, as may be specified by the Engineer shall be followed:

IS: 226 - Structural steel (Standard Quality)

IS: 800 - Code of Practice for general construction in steel.

IS: 806 - Code of practice for use of steel tubes in general building construction.

IS: 808 - Rolled steel beams, channels, and angle sections

IS: 813 - Scheme of symbols for welding

IS: 814 - Covered electrodes for metal arc welding of structural steel

IS: 815 - Classification and coding of covered electrodes for metal arc welding of structural steels.

IS: 816 - Code of practice for use of metal arc welding for general construction in mild steel

IS: 817 - Code of practice for training and testing metal arc welders

IS: 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations

IS: 822 - Code of practice for inspection of welds

IS: 919 - Recommendations for limits and fits for Engineering

IS: 961 - Structural Steel (High Tensile)

IS: 1148 - Rivet bars for structural purposes

IS: 1149 - High tensile rivet bars for structural purposes

IS: 1161 - Steel Tubes for structural purposes

IS: 1200 - Method of measurement of steelwork and ironwork (Part 8)

IS: 1239 - Mild Steel Tubes

IS: 1363 - Black hexagon bolts, nuts and lock nuts (dia. 6 to 30 mm) and black hexagon screws (Dia 6 to 24 mm)

IS: 1364 - Precision and semi-precision hexagon bolts, screws, nuts and l locknuts (Dia, range 6 to 39 mm)

IS: 1367 - Technical supply conditions for threaded fasteners

IS: 1442 - Covered electrodes for the metal are welding of high tensile structural steel

IS: 1608 - Method for tensile testing of steel products other than sheet strip, wire and tube

IS: 1730 - Dimensions for steel plate, sheet, and strip for structural and general engineering purposes.

IS: 1731 - Dimensions for steel flats for structural and general engineering purposes

IS: 1852 - Rolling and cutting tolerances for hot-rolled steel products

IS: 1977 - Structural steel (ordinary quality) St-42-0

IS: 2062 - Steel for General Structural Purposes

IS: 2074 - Ready mixed paint, red oxide Zinc chromate priming

IS: 2595 - Code of Practice for Radiographic Testing

IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and Steel

IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles

IS: 3757 - High strength structural bolts

IS: 4759 - Specifications for Hot-Dip Zinc Coatings on Structural Steel and other allied products

IS: 7205 - Safety Code for Erection of Structural Steelwork

IS: 7215 - Tolerances for fabrication of steel structures

IS: 7280 - Bare wire electrodes for submerged arc welding of structural steels.

IS: 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels.

**2.04.00 Conformity with Designs**

The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum Utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

**2.05.00 Materials to be used**

**2.05.01 General**

All steel materials required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tones or less of any particular section.

The arc welding electrodes shall be of approved reputed manufacture and conforming to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and

amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.

**2.05.02 Steel**

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable:

a) IS: 2062 - Steel for general structural purposes

b) IS: 961 - Structural steel High Tensile

c) IS: 1977 - Structural steel (Ordinary quality) St-42-0

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

**2.05.03 Rivet Steel**

All rivet steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable:

a) IS: 1148 - Rivet Bars for structural purpose

b) IS: 1149 - High tensile rivet bars for structural purposes. Where high tensile steel is specified for rivets, steps shall be taken to ensure that the rivets are so manufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired.

**2.05.04 Electrodes**

All electrodes to be used under the Contract shall be of approved reputed manufacture, low hydrogen electrode and shall comply with any of the following Indian Standard Specifications as may be applicable

a) IS: 814 - Covered electrodes for metal arc welding of structural steel

b) IS: 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel

c) IS: 1442 - Covered electrodes for the metal arc welding of high tensile structural steel

d) IS: 7280 - Bare wire electrodes for submerged arc welding of structural steels

**2.05.05 Bolts and Nuts**

All bolts and nuts shall conform to the requirements of Indian Standard Specification IS: 1367 - Technical Supply Conditions for Threaded Fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

a) Mild Steel

All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 _/A, where "A" is the cross sectional area of the test specimen

i) IS: 1367: Technical supply conditions for threaded fasteners

ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip, wire and tube

b) High Tensile Steel

The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS: 1367 or as approved by the Engineer.

**2.05.06 Washers**

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract:

a) IS: 2062 - Steel for general structural purposes

b) IS: 961 - Structural Steel (High Tensile Quality)

c) IS: 1977 - Structural steel (Ordinary Quality) St-42-0

d) IS: 6649 - Hardened washers

**2.05.07 Paints**

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS: 2074 - Ready Mixed Paint, Red oxide Zinc Chromate Priming.

**2.06.00 Coal Bin**

**2.06.01** Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have been conical-cum-hyperbolic or any other profile shape as shown in the drawing. Bin shall be termed as bunkers or silos according to their shape and plane of rupture of coal.

**2.06.02** For general requirements, fabrication and construction details IS: 9178 (Pt. l & 11) shall be followed as general guidance. The bins shall be fabricated and erected in segments.

**2.06.03** The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face.

**2.06.04** Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process.

**2.06.05** Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing.

**2.07.00 New Erection Marks**

**2.07.01** Additional structures involving new erection marks may be required to be added at any stage of work.

**2.07.02** All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter.

**2.07.03** All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.

## 2.08.00 ELECTRO FORGED STEEL GRATINGS

**2.08.01** Factory made fabricated electro forged gratings unit with steel conforming to IS: 2062 shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc.

**2.08.02** All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise.

**2.08.03** The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/ scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed.

**2.08.04** The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance.

**2.08.05** Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses.

**2.08.06** The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be provided on the grating to suit the profile so obtained.

**2.08.07** Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars.

**2.08.08** Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel.

**2.08.09** Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.

**2.08.10** Grating units shall be provided with all necessary clips, bolts, nuts and lock washers required for proper assembly and rigid installation and fastening to abutting units supporting structural steel framing members.

**2.08.11** The gratings shall be of reputed make and manufacturer, as approved by Engineer. The unit rate quoted by him for this item shall be inclusive of transport of gratings to the project site, all taxes, duties etc. He shall also provide all facilities and access to the Engineer or his representative to carry out inspection during all stages of manufacturing of gratings.

**2.08.12** Maximum deviation in linear dimension from the approved dimension shall not exceed 12mm.

**2.08.13** All fabricated grating section and accessories shall be blast cleaned to near white metal surface (Sa 2½) followed by either of the following two:

(a) Two coats of red lead primer and two coats of black enamel finish paint.

(b) Hot dipped galvanization at 610 gm/sq.m.

in the shop prior to erection at site, as the approved drawing.

**2.08.14** Prior to finishing all surfaces shall be cleaned, free from rust, mill scale, grease, oil, or any other foreign matter by blast cleaning. BS: 4232 shall be followed for blast cleaning.

**2.08.15** Primer can be applied by spray guns or by brushes, however the finish paint shall necessarily be applied by means of spray guns. The applied coatings shall be uniform, free from voids and streaks; drilled or punched holes shall be touched up prior to erection or assembly.

**2.09.00 GALVANIZATION OF GRATINGS**

**2.09.01** Purity of Zinc to be used-for galvanizing shall be 99.5% as per IS: 2 15

**2.09.02** After the shop work is complete, the structural material shall be punched with erection mark and be hot double dip galvanized. Before galvanizing the steel section shall be thoroughly blast cleaned to near white metal surface (Sa 2½).

**2.09.03** The weight of the zinc coating shall be at least 610 gm/m² - unless noted otherwise.

**2.09.04** The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be cleaned and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter that is loosely attached to

the steel, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

**2.09.05** There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633.

**2.09.06** When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose.

**2.09.07** Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection.

**2.09.08** All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains.

**2.09.09** If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to the redone in the similar manner as stated above at no extra cost to the Owner.

**2.10.00 STAINLESS STEEL HOPPERS (As per BOQ item)**

**2.10.01 Material**

In case SS Hopper is to be fabricated & erected as per BOQ item with SS415M, following specification shall be followed.
Stainless steel hopper of grade SS 415M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 4 15M having the following chemical composition shall be used.

| **Material** | **%** | **Remarks** |
|---|---|---|
| Carbon | 10.03% | Max. |
| Silicon | 1.60% | Max. |
| Manganese | 0.80% to 1.50% | |
| Phosphorous | 0.03% | Max. |
| Sulphur | 0.03% | Max. |
| Chromium | 10.80% to 12.50% | |

| | | |
|---|---|---|
| Nickel | 1.50% | Max. |
| Titanium | 0.75% | Max. |
| Nitrogen | 0.03% | Max. |

**The mechanical properties shall be as follows:**

| **Description** | **Value** | **Remarks** |
|---|---|---|
| Hardness Rock Well B Scale | 90 | Max. |
| Tensile Strength | 450 MPa | Min. |
| Yield Strength | 300 MPa | Min. |
| Elongation | 25% | Min. |

**2.10.02 Fabrication**

The fabrication, erection, alignment and welding shall be carried out as per the accepted practice and in accordance with relevant I.S. and international specification as well as stipulations contained herein. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication drawings.

**2.10.03 Fabrication Drawings**

a) Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly, the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also require adjustment in the size of each element of hopper plate and also additional weld joints.

b) The bill of material of hopper plate shall indicate the inner surface area of the hopper, weight of the hopper based on the inner surface area, weight of each of the cut plate of hopper fabrication, weight of cut and scrap pieces generated. Contractor shall return to the Owner's store all unutilized (surplus) stainless steel plates and all waste and cut pieces generated. Non return of any part of the surplus/waste steel pieces to the Owner's store

will call for the penal recovery at three (03) times the maximum procurement rate for the weight of stainless steel pieces not returned to the store.

c) In case the contractor does the cutting of the stainless steel without approved cutting plan then all the wastage (i.e. the difference between the weight of stainless steel plate cuts and the actual finished weight considered for the measurement for payment) shall be subjected to the penal recovery at the rate mentioned above.

**2.10.04 Cuffing**

Cutting may be affected by shearing, or by using plasma. The cut edges of all plates shall be perfectly straight and uniform through out. Cutting shall be done as per the cutting plan shown in the fabrication drawing. Should the Engineer find it necessary, the edges shall be ground smooth afterwards by contractor within the unit rates quoted by him. All the edge s shall be ground smooth before they are welded.

**2.10.05 Jointing**

Welding shall join stainless steel. All weld joints (along the inclined plane) shall be staggered. Any common welding process can weld stainless steel viz. MIG, metal arc or plasma using the covered compatible electrodes as per IS: 5206 or by inert gas arc welding as per IS: 2811. Shielding gas shall be Argon + Hydrogen mixture or Argon + Oxygen mixture. However, Argon + Oxygen mixture shall be preferred. Carbon-di-oxide mixture shall be avoided. 308L and 315L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test.

**2.10.06 Bending**

The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile.

**2.10.07 Welding sequence**

The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer.

**2.10.08 Acceptance Criteria of Fabricated Structures**

The acceptance of the fabricated structure work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory

results from the inspection and testing of the welded structure joints and the test specimens, general workmanship being good meeting the tolerance requirements given in IS: 7215.

## 2.11.00 BEARINGS

### 2.11.01 PTFE (Poly tetra fluorethylene) slide bearing

**a) General**

The bearings shall consist of upper and lower units. The upper unit shall include a sole plate with mirror finish stainless steel facing bonded to the bottom surface of the sole plate. The lower unit shall consist of a relevant laminated elastomers pad surfaced with PTFE. A rigid confining medium substructure bonds the PTFE to the pad. When the upper and lower units are mated the stainless steel slides on the PTFE surface with an extremely low coefficient of friction. These bearings shall be designed as per the performance requirements. The bearing shall be of reputed make and manufacturer as approved by Engineer, for required vertical loads, as per the construction drawings and for a maximum displacement of ± 50 mm.

**b) Material**

PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/cm². In order to prevent cold flow in the PTFE surface it shall be rigidly bonded by a special high temperature resistant adhesive to the stainless steel sub-strata. The stainless steel surface, which slides against the PTFE, is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of the stainless steel shall be between 1.0 to 1.5mm.

The resilient bearing pad shall consist of multiple layers of lightweight fabric impregnated with a high quality elastomer compound vulcanized into slabs of uniform standard thickness as per the requirement. This shall withstand vertical (compressive) load not less than 500 kg/cm² and shear loads upto 40 kg/cm².

**c) Installation**

The seating area for PTFE bearing shall be prepared accurately level and furnished with a thin layer of epoxy resin mortar. The bearing will be placed on this layer while it is still workable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the mortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surface of the bearing shall then be coated with sufficient thickness of epoxy resin mortar so that when the

beam is lowered on to the temporary supports it comes into full contact with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed.

**2.12.00 Storage of material**

**2.12.01 General**

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

**2.12.02 Steel**

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

**2.12.03 Electrodes**

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

**2.12.04 Bolts, Nuts and Washers**

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality.

**2.12.05 Paints**

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

## 2.13.00 Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work

a) Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.

b) Rivets, Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing.

c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.

d) Welders : Qualifying Tests

e) Welding sets : Performance Tests

f) Welds : Inspection, X-ray, Ultrasonic tests

g) Paints : Manufacturer's certificate, physical inspection reports

h) Galvanizing : Tests in accordance with IS 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

## 2.14.00 Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

## 2.15.00 Fabrication Drawings

The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval.

The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The fabrication drawings shall include but not limited to the following:

a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.

b) Dimensional drawings of base plates, foundation bolts location etc.

c) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings.

d) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.

e) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information

necessary for fabrication of the various components of the steelwork, including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification. IS: 813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The Contractor shall be responsible for and shall carry out at his cost any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract.

## 3.00.00 WORKMANSHIP

### 3.01.00 Fabrication

#### 3.01.01 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for general construction in steel and other relevant Indian Standards or equivalent.

#### 3.01.02 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification on IS: 1552 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C.

#### 3.01.03 Cutting

Shearing, cropping, or sawing shall affect cutting. Use of a mechanically controlled gas-cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under

expert hand, subject to the approval of the Engineer.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

**3.01.04 Planning of edges**

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

**3.01.05 Clearances**

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams web shall be not more than 3 mm at each end, but where for practical reasons greater clearance is necessary, suitably designed cheatings shall be provided.

**3.02.00 Riveted and bolted construction**

**3.02.01 Holes**

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of rivet or bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of BS as

specified in IS: 919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for rivets or bolts shall not be formed by gas cutting process.

**3.02.02 Assembly**

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1 125°C they shall not be driven after their temperature has fallen below 540°C.

Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required.

Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular

section or group shall be cut, removed and replaced and tested again at the Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project trough the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings.

## 3.03.00 Welded Construction

### 3.03.01 General

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817.

### 3.03.02 Preparation of material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.

### 3.03.03 Assembling

Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°).

The work shall be positioned for flat welding whenever practicable.

### 3.03.04 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shod splicing not more than three sub-sections, each made in accordance with this paragraph.

When required by the Engineer, welded assemblies shall be stress relieved by heat-treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

### 3.03.05 Welding technique

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 m thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material, as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the contract.
To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards.

### 3.03. 12 Temperature

No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to undertaken at low temperature, adequate

precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5°C and 0°C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

**3.03. 13 Peening**

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

**3.03. 14 Equipment**

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer.

**3.04.00 Finish**

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0 mm.

**3.05.00 Slab bases and caps**

Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face.

To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

**3. 12.00 Lacing bars**

The ends of lacing bars shall be neat and free from burns.

**3. 13.00 Separators**

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

**3.14.00 Bearing Plates**

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

**3.15.00 Floor Grating**

All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively, diamond pattern grating if approved may be used.

The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer.

The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes, ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered. Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width.

Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm.

**3.10.00 Chequered Plates**

Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration.

**3.11.00 Architectural Clearances**

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

**3.11.00 Shop connections**

a) All shop connections shall be otherwise riveted or welded as specified on the Drawings.

b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection.

c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer.

**3.13.00 Castings**

Steel castings shall be annealed.

**3.14.00 Shop erection**

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchange ability.

### 3.15.00 Shop painting

### 3.15.01 General

Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush.

### 3.15.02 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

### 3.15.03 Contact surfaces

Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly.

### 3.15.04 Finished surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

### 3.15.05 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

## 3.16.00 Galvanizing

### 3.16.01 General

Structural steelwork for switchyard or other structures as may be specified in the contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

### 3.16.02 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

### 3.16.03 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS: 4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after leaving been dipped twice, it shall be rejected. Special care shall be taken

not to injure the skin on galvanized surfaces during transport, handling, and erection. Damages, if occur, shall be made good in accordance or as directed by the Engineer.

## 4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

### 4.01.00 Inspection

Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification.

### 4.02.00 Testing and Acceptance Criteria

### 4.02.01 General

The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own Cost. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

### 4.02.02 Steel

All steel supplied by, the Contractor shall conform, to the relevant Indian Standards. Except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be born by the contractor.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.

**4.02.02 Welding**

a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc.

b) Non-destructive examination shall be carried out to determine soundness of weldments as follows:

   i) 10% at random on fillet-joints.

   ii) 100% on all butt-joints.

c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs.

d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor.

**4.02.04 Rivets, bolts, nuts and washers**

All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost.

**4.02.05 Shop painting**

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.

**4.02. 12 Galvanizing**

All galvanizing shall be uniform and of standard quality when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and 15: 4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

**4.03.00 Tolerance**

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS: 1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures.

**4.04.00 Acceptance**

Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost.

When all tests to be performed in the Contractor’s shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

**4.05.00 Delivery of materials**

**4.05.01 General**

The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

**4.05.02 Marking**

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

**4.05.03 Shipping**

Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following:

a) Name and address of the consignee

b) Name and address of the consignor

c) Gross weight of the package in tonnes and its dimensions

d) Identification marks and/or number of the package

e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially -

a) Name of the Contractor

b) Number and date of the Contract

c) Name of the office placing the contract

d) Nomenclature of stores

e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each.

The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner.

Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor.

The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges.

If, however, the Owner has to make payment of any of the above-mentioned charges, the amount paid will be deducted from the bills of the Contractor.

Necessary advice regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

## 5.00.00 INFORMATION TO BE SUBMITTED

### 5.01.00 With Tender

The following information is required to be submitted with the Tender:

a) Progress Schedule

The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work.

i) Preparation and approval of fabrication drawing

ii) Procurement of Materials

iii) Fabrication and shipping of all anchor bolts

iv) Fabrication and shipping of main steelwork.

v) Fabrication and shipping of steelwork for bunkers, tanks and/or silos as applicable.

vi) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork.

vii) Final date of completion of all shipments.

b) Shop

Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity, and the capacity that will be available exclusively for this contract shall be submitted.

**5.02.00 After Award**

After award of the Contract the successful Tenderer is to submit the following:

a) Complete fabrication drawings, material lists, cutting lists, rive and bolt lists, field welding schedules based on the approved design drawings prepared by him in accordance with the approved schedule.

b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day o. each month, giving the up-to-date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information.

c) Detailed monthly material reconciliation statements relevant to the Work done and reported in the Progress Report, giving the stock at hand of raw steel, work in progress, finished materials.

d) Results of any test as and when conducted and as require by the engineer.

e) Manufacturer’s mill test report in respect of steel materials, rivets, bolts, nuts, and electrodes as may be applicable.

## 6.00.00 RATES AND MEASUREMENT

### 6.01.00 Rates

**6.01.01** The items of work in the Schedule of items describe the work in brief. The various items of the Schedule of items shall be read in conjunction with these specifications including amendments and additions, general conditions of contract, special conditions of contracts, and other tender documents, if any. For each item of Schedule of Items, the bidder's rates shall include the activities covered in the description of the item as well as all necessary operations described in the Specifications.

**6.01.02** The bidder's rates shall include cost of all minor details which are obviously and fairly intended and which may not have been included in the description in these documents but are essential for the satisfactory completion of the work. Rates shall also include for taking all safety measures.

**6.01.03** The bidder's -rates for all items of schedule of items shall include complete cost towards plant, equipment, erection and dismantling of scaffolding, men, materials and consumables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectification/maintenance until handing over, contingencies, overhead and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work.

**6.01.04** No claims shall be entertained, if the details shown on the `Released for Construction' drawings differ from those shown on the bid/tender drawings.

**6.01.05** Rates shall be inclusive of all leads and lifts/elevation.

**6.01.06** The bidder's rates for Structural Steel shall include for fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, erection scheme, alignment, welding, including preheating and post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus/waste steel materials including cut pieces'/waste steel, provision of additional butt/weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

**The rates for fabrication are inclusive of all tests on welds and material and no extra shall be payable for quality tests specified for fabrication of structure in shop or at site.**

**Separate BOQ items for test on welds like radiography or Ultrasonic, DPT, magnetic particle tests are kept for tests on material/fabrication not covered under regular fabrication item of BOQ.**

**6.01.07** The bidder's rates for foundation bolts assembly shall include fabrication, threading, heat treatment, erection, installation, and alignment of complete bolt assembly with nuts, locknuts, anchor plates, stiffener plates, protective tape, etc. This shall also include the cost of all materials not issued by the Owner. Material issued by Owner will be specified in GCC.

**6.01.08** The bidder’s rates for application of inorganic primer shall include surface preparation to near white metal surface by blast cleaning, abrasives, touch up painting, suitable enclosure to avoid contamination and the necessary statutory approval from the factory inspector/pollution control board etc. regarding the method of blast cleaning and abrasives used, and getting approval of the specialized agency supplying the primer specified.

**6.01.09** The bidder's rates for application of finish painting system shall include surface preparation, application of intermediate (under) coat, finish coat and final finish coat, and getting approval of the specialized agency supplying the finish paint.

**6.01.10** The bidder's rates for electro-forged gratings (if specified) shall include supply, fabrication, transportation to the site, erection and alignment of factory made electro-forged gratings, all taxes, duties thereon etc. The rates shall also include preparation of grating design for different spans and load intensifies, preparation of design and fabrication drawings, edge preparation, blast cleaning followed by finish paint.

**6.01.11** The bidder's rates for galvanization of factory made electro-forged gratings (if specified) shall include the application of hot dipped galvanization as finish over the fabricated gratings and the treatment to be given for prevention of white storage stains, as per the technical Aspiration.

**6.01.12** The bidder’s rates for permanent mild steel bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types of Structural Steel works, as per the technical specification.

**6.01.13** The bidder’s rates for high strength structural bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types, of Structural Steel works, as per the technical specification.

**6.01.14** The bidder's rates for dismantling, additions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as mentioned in the technical specification. Unutilised steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unublized steel pieces to the Owner's store would be considered as wastage and recovery would be affected as per the provision of contract for structural steel consumption. This shall not include the weight of temporarily dismantled/supported members, connected member.

**The bidder should prepare an optimised cutting plan as per fabrication drawing to utilise the steel material upto maximum extent and minimise the wastage/scrap. Quantity of wastage/scrap of material should be limited to the percentage mentioned elsewhere in the conditions of tender/ contract specifications.**

**6.01.15** The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight.

**6.01.16** The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc.

**6.01.17** The bidder's rates for Stainless Steel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary structures etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus / waste steel materials including cut pieces'/waste steel, provision of additional butt / weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

**6.01.18** The bidder's rates for preformed flexible open ended bellow strap of neoprene (if specified) shall include supply and transportation, installation in position, drilling, bolting, aligning etc. complete along with any taxes, duties thereon etc.

**6.01.19** The bidder's rates for Stainless Steel Hand Rail (if specified) shall include complete Hand Rail including, materials, fabrication, grinding & finishing, stainless steel beading, stainless steel cleats, stainless steel fasteners, neoprene gaskets, preparation of shop drawing but excluding the cost of glazing. The Owner shall supply no material for this item of work.

**6.02.00 MODE OF MEASUREMENT**

**6.02.01** The measurement for the item of foundation bolts assembly including that of nuts; locknuts shall be based on the calculated weight of steel installed in Metric Tonne, corrected to second place of decimal. The weight of the foundation bolt shall be calculated in the same way as that done for the item of fabrication, erection, alignment of structural steel. The weight of the nut / locknut shall be taken as per actual weight supplied by the contractor and accepted by the Engineer.

**6.02.02** The measurement for the item of fabrication, erection, alignment, welding, etc. of structural steel work shall be based on the approved weight of steel nearest to a Kg, by applying the unit weight as adopted at the time of issue of structural steel on the measurements worked out as given below.

**6.02.03** For ISMB, ISMC, ISA, flats, round bars, square bars and pipes, length shall be taken as per distance between planes normal to the axis of the member passing through the extreme points of the section.

**6.02.04** Gussets plates in trusses, and bracings, brackets plates, stiffeners, and skew cuts if any in plates for butt welds, the area shall be assumed as the minimum circumscribed rectangle. However, deduction for any notch/skew cut shall be made as mentioned in clause no-6.02.06.

**6.02.05** For bunker wall plates, the minimum-circumscribing rectangle of the individual plate/pieces out of which these wall plates are assembled by butt-welding, shall be measured. Care shall be taken to ensure maximum utilization of cut-pieces generated by providing extra butt joints (for which no extra payment shall be made).

**6.02.06** For all other plates, where the area of any notch/skew cut in the plate is less than 0.05 sq.m. the area of the plate shall be assumed as that of the minimum circumscribing rectangle for the purpose of measurement and calculation of area for the purpose of payment. However, if the area of any notch/skew cuts in a plate is more than 0.05 sq.m, the area of notch/skew cut shall be deducted

from assumed minimum circumscribing rectangular area for the purpose of payment.

**6.02.07** No deduction shall be made for the hole in the members, if the area of individual hole is less than 0.05 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.05 sq.m.

**6.02.08** All cut-pieces and scrap generated due to cutting of holes, skew-cuts of plates, gussets, brackets, stiffeners, etc. shall be stacked separately and handed over to the project stores without being considered for material accounting as the circumscribing rectangle has been considered for payment.

**6.02.09** The splice plate shown in the fabrication drawing or approved by the Engineer shall only be measured for payment.

**6.02.10** The weight of permanent bolts, washers and nuts and welds shall not be included in the weights of the members. No extra payment shall be made for welding/bolting.

**6.02.11** The bolts and nuts required for erection purpose shall not be paid for and may be taken away by the Contractor after final welding for members. Erection boltholes left after removal of erection bolts shall be suitably plugged with welds.

**6.02.12** The measurement for the item of application of inorganic primer including blast cleaning of steel surfaces shall be based on the weight on which the zinc silicate primer is applied, after blast cleaning in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works.

**6.02.13** The measurement for the item of application of finish primer system shall be based on the weight on which the epoxy based finish primer is applied in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works.

**6.02.14** The measurement for the item of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor, and accepted by the Engineer. Nothing extra shall be payable for making cutouts, notches, openings of any profile, trimming profiles etc. in the grating units.

**6.02.15** The measurement for the item of hot dipped galvanization of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal of gratings galvanized by the Contractor and accepted by the Engineer.

**6.02.16** The measurement for the item of permanent bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.

**6.02.17** The measurement for the item of High Strength Structural bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.

**6.02.18** The measurement for the item of the work of dismantling, additions, alterations, reerection etc. shall be as given below

**6.02.19** For dismantling, the unmodified weight of the actually dismantled erection marks shall only be measured.

**6.02.20** For the work of addition to, alteration in and / or modification of 'erection marks' either in erected position or in the fabrication yard, measurement of weight for payment purpose shall be calculated as the arithmetic sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark.

**6.02.21** For re-erection the weight of the modified erection mark shall only be measured.

**6.02.22** The weight shall be measured nearest to kg. and shall be arrived in a manner similar to the measurement for the item of fabrication, erection, alignment and welding of structural steel.

**6.02.23** The measurement for the item of PTFE bearings shall be based on the load carrying capacity of PTFE in MT, corrected to third place of decimal, supplied by the contractor and as accepted by the Engineer and as per the approved bearing schedule, for the total vertical load carrying capacity, for all bearings.

**6.02.24** The measurement for the item of stainless steel hopper shall be based on the actual finished weight of hopper weight in Kgs, corrected to second place of decimal. The hopper weight shall be arrived by multiplying of the inner surface area of the hopper with the unit weight of the hopper plate.

**6.02.25** The measurement for the item of flexible open-ended bellows straps of neoprene shall be based in running meter, corrected to second place of decimal. Bellow Straps shall be supplied as per the requirement of the approved drawings. The measurement shall be done for the inner circumference of the bunker on which neoprene has been fixed and for the length supplied by the Contractor 'and as accepted by the Engineer.

**6.02.26** The measurement for the item of Stainless Steel Hand Railing shall be based on finished weight of handrail in Kgs corrected to second place of decimal. The weight shall also include the weight of Stainless Steel fasteners, Stainless Steel beading, Stainless Steel cleats etc. The weight shall be the finished weight of Hand Rail, as accepted by the Engineer.

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C018 |
|---|---|---|
| | **TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK** | VOLUME - II B |
| | | SECTION - D SUBSECTION – D18 |
| | | REV.NO. 0 DATE 03/10/2017 |
| | | SHEET 1 OF 17 |

# VOLUME: II B

## SECTION - D
## (PART I)

## SUB-SECTION – D 18

## ERECTION OF STRUCTURAL STEELWORK

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C018 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK** | VOLUME - II B |
| | | SECTION - D SUBSECTION – D18 |
| | | REV.NO. 0 DATE 03/10/2017 |
| | | SHEET 2 OF 17 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | SCOPE | 3 |
| 2.00.00 | GENERAL | 3 |
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| 5.00.00 | INFORMATION TO BE SUBMITTED | 16 |

# SUB-SECTION – D 18

## ERECTION OF STRUCTURAL STEELWORK

### 1.00.00 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

### 2.00.00 GENERAL

**2.01.00** Work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:

a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour, and supervision required for erection of the structural steelwork.

b) Receiving, unloading, checking, and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.

c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.

d) Checking centre lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be rectified with Engineer's approval. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.

e) Aligning, plumbing, levelling, riveting, bolting, welding and securely fixing the fabricated steel structures including floor gratings, chequered plates etc. in accordance with the Drawings or as directed by the Engineer.

f) Painting of the erected steel structures.

g) All minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following:

i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.

ii) Cutting, chipping, filling, grinding, etc. if required for preparation and finishing of site connections.

iii) Reaming of holes for use of higher size rivet or bolt if required.

iv) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated.

v) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.

vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.

vii) Carry out tests in accordance with this specification.

**2.02.00 Work by Others**

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

**2.03.00 Codes and Standards**

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent:

IS: 800 - Code of practice for general construction in steel.

IS: 456 - Code of practice for main or reinforced concrete.

**2.04.00 Conformity with Designs**

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of this specification and /or instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specifications and/or the instructions o the Engineer.

**2.05.00 Material**

**2.05.01 General**

All fabricated steel structures and connection materials shall be supplied by the Contractor to the site. The Contractor shall take delivery from railway wagons or trucks at site, and unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.01.00 and as specified hereinbefore.

**2.05.02 Materials to conform to Indian standards**

All materials required to be supplied by the Contractor under this contract shall conform to the relevant Indian Standard specifications.

**2.06.00 Storage of Materials**

**2.06.01 General**

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues.

**2.06.02 Yard**

The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other raw steel materials such as structural sections and plates as required. The yard shall have facilities like drainage, lighting, and suitable access for large cranes, trailers, and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved Programme of work.

The Tenderer must visit the site prior to submission of his tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer.

**2.06.03 Covered Store**

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.

**2.07.00 Quality Control**

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the Following items of work:

i) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

ii) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency, and strength of grout.

iii) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

**2.08.00 Taking Delivery**

The Contractor shall take delivery of fabricated structural steel and necessary connection materials from railhead/trucks as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him.

The Contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect, and deliver all the packing materials to the Owner free of charge.

**3.00.00 WORKMANSHIP**

**3.01.00 Erection**

**3.01.01 Plant and Equipment**

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be thoroughly verified. They shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.

### 3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Contractor shall arrange for most economical method and sequence available to him consistent with the drawings and specifications and other relevant stipulations of the contract.

### 3.01.03 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erecrtion shall install, free of cost to the Owne, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The requirement of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned, and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work, and cribbing shall not be the property of the Owner and they may be removed immediately upon completion of the steel erection.

### 3.01.04 Temporary Floors for Buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or bylaws of state, Municipal or other local authorities.

### 3.01.05 Setting Out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns, etc. the Contractor shall set proper screed bars to maintain proper level. No extra payment shall be made for this.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance under this Specification.
No permanent field connections by riveting, bolting or shall be carried out until proper alignment and plumbing has been attained.

**3.01.06 Field Riveting**

All rivets shall be heated and driven with pneumatic tools. Hand passing or "throwing" of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No-cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

**3.01.07 Field Bolting**

All relevant Portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other, defects that would prevent solid seating of the parts. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the Joint are brought into good contact with each other. 'Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-I with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation

there shall be no rotation of the part not turned by the wrench.

**TABLE-I**

| Bolts length not exceeding 8 times Dia or 200 mm | Bolt length exceeding 8 times Dia or 200 mm | Remarks |
|---|---|---|
| 1/2 turn | 2/3 turn | Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation-30° over or under. |

Bolts may be installed without hardened washers when tightening is done by the turn -of-nut -method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II (See Note below the Table). Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

**TABLE-II**

| Nominal Bolt Diameter (mm) (Kg.M) of IS:1367 | Torque to be applied for bolt class 8.8 |
|---|---|
| 20 | 59.94 |
| 22 | 81.63 |
| 24 | 103.73 |

Note: The above torque values are approximate for providing tensions of 14. 7 T for 20 mm dia.; and 21.2 T for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds. Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

### 3.01.08 Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

### 3.01.09 Holes, Cutting and Fitting

No cutting of sections, flanges, webs, cleats, rivets, bolts, welds etc. shall be done unless specifically approved and /or instructed by the Engineer.

The erector shall not cut, drill, or otherwise alter the work of other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is obtain specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work.

### 3.02.00 Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge

holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

**3.03.00 Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)**

Grouting shall be carried out with Ordinary Cement grout as described below:

The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Engineer or shown on the drawings.

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, leveled, and plumbed and sufficient floor beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

If required by the Engineer, certain admixtures like aluminium powder, “ironite” or equivalent, may be required to be added to the grout to enhance certain desirable properties of the grout. Approved non-shrink pre-mixed grout having required flowability and compressive strength may also be used with Engineer's approval.

**3.04.00 Painting after Erection**

Field painting shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. Normally, final painting shall be done only after the floor slabs are concreted and masonry walls are built. However, touch up painting, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the Contractor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance

with the requirements of the specification for fabrication of structural steelwork applicable for the project.

Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field rivets, bolts, welds, and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces, which will be in contact after site assembling, shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface, which will be inaccessible after field assembly shall receive the full, specified protective treatment before Bolts and fabricated steel members who are galvanized or otherwise treated and steel members to be encased shall not be painted.

The final painting shall be of tow coats of Synthetics Enamel painting or Aluminium paint of approved manufacture as per the approved "Schedule of Painting". The shades shall also be as per the approved schedule. Synthetic enamel paint shall conform to IS: 2932.

**3.05.00 Final cleaning up**

Upon completion of erection and before final acceptance of the work by the Engineer, the contractor shall remove free of cost all false work, rubbish and all Temporary Works resulting in connection with the performance of his work.

**4.00.00 TESTING AND ACCEPTANCE CRITERIA**

**4.01.00 General**

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract and no payment towards the cost of the dismantled portion and any connected work shall be made to the contractor. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the Contractor, to the satisfaction of the Engineer. The Cost of the tests specified hereinafter shall be borne by the Owner; but if the structure fails to pass the tests, the cost of the tests shall be recovered from the Contractor. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable

and appropriate time extensions will be allowed.

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following sub-clauses 4.01.01, 4.01.02 and 4.01.03. The method of testing and application of loading shall be as approved by the Engineer.

**4.01.01 Stiffness Test**

In this test, the structure or member shall be subjected, addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test.

**4.01.02 Strength Test**

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on the removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

**4.01.03 Structure of same design**

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

**4.01.04 Repair for subsequent test and use after strength tests**

An actual structure which has passed the “Strength Test” as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.01.01 hereinbefore.

**4.02.00 Tolerances**

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steel work applicable to this Project and as specified below: The specified tolerance is mainly for welded erection. In case of bolted erection, no tolerance is desired so that all prefabricated bolt holes are matched on erection.

I. For Buildings Containing Cranes

| Component | Description | Variation Allowed |
|---|---|---|
| 1. | 2. | 3. |
| Main columns | a) shifting of column axis at foundation level with respect to building line | |
| | i) In longitudinal direction | i) ± 3.0 mm |
| | ii) In lateral direction | ii) ± 3.0 mm |
| | b) Deviation of both major column axis from vertical between foundation and | |

| | | |
|---|---|---|
| | other member connection levels: | |
| | i) For a column upto and including 10M height | i) ± 3.5 mm from true vertical |
| | ii) For a column greater than 10M but less than 40M height | ii) ± 3.5 mm from true vertical for any 10 M length measured between connection levels, but not more than ±7 mm per 30m length. |
| | c) For adjacent pairs of columns across the width of the building prior to placing of truss | ± 9.0 mm on true span. |
| | d) For any individual column deviation of any bearing or resting level from levels shown on drawings. | ± 3.0 mm |
| | e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating | 3.0 mm |
| Trusses | a) Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord. | 1/1500 of the span or greater than 10mm whichever is the least. |
| Trusses | b) Lateral displacement of top chord at center of span from vertical plane running through center of supports. | 1/250 of depth of truss or 20 mm which ever is the - least. |
| Crane Cirders | a) Difference in levels of crane rail measured between adjacent columns. | 2.0 mm. |
| | b) Deviation to crane rail-gauge | ± 3.0 mm |

| | | |
|---|---|---|
| | c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermite welding. | 1.0 mm. |
| | d) Deviation of crane rail axis from centre line of web. | ± 3.5 mm |
| Setting of Expansion gaps | At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length. | |

iv) For Building without Cranes

The maximum tolerances for line and level of the steel work shall be ±3.0 mm on any part of the structure. The structure shall not be Out of Plumb more than 3.5 mm on each lox section of height and not more than 7.0 mm per 30 m section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

**4.03.00 Acceptance**

Structures and members have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.01.00, 4.01.01, 4.01.02, 4.01.03 and 4.01.04 and other applicable provisions of this specification and are within the limits of tolerances specified in Sub-clause 4.02.00 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this contract.

**5.00.00 INFORMATION TO BE SUBMITTED**

**5.01.00 Before Tender**

**5.01.01 Tentative Programme**

The Tenderer shall submit a tentative programme based on the information available in the Tender Document and visit to site indicating the structure-wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.

**5.01.02** Constructional Plant and Equipment, Tools, Temporary works & manpower A detailed list of all constructional plant and equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

**5.01.03 Erection Yard**

A site plan showing the layout and location of the erection yard proposed to be established by the tenderer shall also be attached with the tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.

**5.02.00 After award of the Contract**

After award of the contract, the Contractor shall submit the following:

**5.02.01 Detailed Programme**

The Contractor shall submit a detailed erection programme within a month of the award of the Contract for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required, and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.

**5.02.02 Fortnightly Progress Report**

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.02.01 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C019 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR ROOF DECKING** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D19<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 1 OF 7 |

# VOLUME: II B

## SECTION - D

### SUB-SECTION – D19

### ROOF DECKING

## SPECIFICATION NO. PE-TS-999-600-C019

Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C019 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR ROOF DECKING** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D19<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 2 OF 7 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | SCOPE | 3 |
| 2.00.00 | MATERIALS | 3 |
| 3.00.00 | INSTALLATION | 3 |
| 4.00.00 | ACCEPTANCE CRITERIA | 6 |
| 5.00.00 | IS CODES | 6 |
| 6.00.00 | RATES AND MEASUREMENTS | 7 |

# ROOF DECKING

**1.00.00 Scope**

This section of the specification covers the supply, fabrication and erection of profiled light gauge Metal Decks (coated and painted) as roof decking to the main plant building and any other area as indicated in the drawings.

**2.00.00 Material**

**2.01.01** Roof of main plant TG and Deaerator bay and bunker building consists of permanently colour coated (on exposed face) galvanized MS trough metal sheet decking plate of approved colour over roof purlins for cast-in-situ roof slab as per IS: 14246 and conform to class 3. Thickness of deck plate shall be minimum 0.8mm and minimum trough depth of 44 mm and center to center of the valley shall be 130mm with minimum yield strength of 250 Mpa. Silicon modified polyester paint shall be used for permanent coating over galvanized surface with minimum rate of galvanization 150 gm/sqm. DFT of permanent colour coating shall be 20 microns. It shall serve as permanent shuttering for cast-in-situ roof slab. It should have adequate strength to support weight of green concrete and imposed load during construction. The thickness of the deck plate shall however be designed suitably according to the spacing of roof purlins.

**3.00.00 INSTALLATION**

The Contractor shall furnish all labour, equipment and materials as required for the design, fabrication, coating, erection and fixing of the decking over purlins, painting and for the complete performance of the work in accordance with the construction drawings and as described herein.

The description, which follows, gives a general indication of the nature and extent of the work but is not necessarily exhaustive and does not purport to cover all the details/operations which will be necessary in order to carry out the work.

**3.01.00 Detailed Design of Roof Decking**

The Contractor, in conjunction with the manufacturer, shall be responsible for the detailing of the profiled decking, fittings and fixtures and shall submit with his tender particulars of the proposed manufacturer and of the particular product proposed for use. The detailing is to be based on typical details furnished by the Engineer. The Contractor shall submit to the Engineer, two copies of the general arrangement and detailed working drawings for the proposed design, together with all calculations necessary to verify the adequacy and completeness of the design & detailing of decking sheets, fixtures, flashings and trims. After approval he shall supply further eight copies.

The Engineer will verify the correct interpretation of his requirements but may not necessarily check the design and details, and the Contractor shall be entirely responsible for the accuracy of the drawings and the correctness of the design and the suitability of the details. Manufacture of roof decking sheets shall not commence until the necessary approval of the Engineer has been obtained.

**3.02.00 Erection & Fixing**

**3.02.01 Sequence of Manufacture/Erection**

Cutting Schedules, delivery to site and stacking arrangements in store shall ensure that sheets are erected in a sequence which follows that for the manufacture. The decking sheets shall be erected using an arrangement of sheets and joints to conform with the requirements of this specification. Decking erection for each elevation or feature shall commence at one end only and proceed towards the other end, in order to ensure tight fitting laps.

**3.02.02 Position and Location of Laps**

Side and end laps of roof decking sheets shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind.

The lines formed by horizontal laps and fixing shall where possible, be continuous and coincide with the edges of large openings in the roof.

**3.02.03 Alignment of Sheets and Fixings**

All roof decking sheets shall be fixed plumb and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be removed from the surfaces of the sheets as the work proceeds.

**3.02.04 Site Cutting**

Approval must be obtained before the roof decking sheets are cut at site. Generally cutting of sheets to length will not be permitted, only special cutting and trimming for small openings shall allowed. Where possible, site cut edges shall be concealed at laps.

**3.02.05 Damaged Sheets**

Distorted, blemished or water stained sheets and any other fittings shall not be used.

**3.02.06 Laps**

End laps and side laps to roof decking sheets shall be sufficiently large to ensure that the decking complies with the weather tightness and other requirements of this specification. The length of each decking sheet shall be adjusted so that the end laps shall bear on the purlins. In no case end laps shall not be less than 150 mm and side laps shall not be less than 53 mm.

**3.02.07 End Lap Fixings**

End lap fixings shall be located at least 25 mm from the end of each sheet.

**3.02.08 Side Lap Fixings**

The spacing of side lap fixings shall ensure compliance with this specification regarding tightness. The spacing of these fixing screws shall not exceed 500mm. The fixing shall be located in the bottom flat of the corrugation.

**3.02.09 Holes**

Holes in MS decking sheets shall be punched. In case holes are drilled holes, it is to be ensured that the holes do not go oversize due to the small thickness of the sheeting. All drilling swarf shall be removed from the surfaces of decking, supporting steel work, purlins etc.

**3.02.10 Location and Spacing of Fixings**

Fixings shall be accurately located in position in the centre of the corrugations to ensure that the heads of bolts, nuts and washers bear squarely down on the surface of the sheeting and are not located at the edge or on the joints in supporting purlins.

**3.02.11 Fixings**

The tenderer shall submit with his tender details of the proposed method for securing the roofing sheets to the metal purlins. The roof decking sheets are to be fixed to the roof purlins with hex washer head white zinc plated heat treated carbon steel self-drilling / self-tapping screws of minimum thread diameter of 5.6mm. These self-drilling screws shall be drilled through the roofing sheets and purlins supporting the roofing sheets. These purlins shall be suitably spaced as per the requirement of roofing sheets and the roofing sheets shall not sag more than span/250 for the loads likely to be imposed during concreting and in future. The self-drilling screws are to be spaced at a maximum distance of 390mm centre to centre along the length of the purlins and top chord of truss. The screws are to be located preferably in the valley only and shall be installed in accordance with the manufacturer's

recommendations using tools approved by the manufacturer which do not damage the coating of the decking sheets.

**3.03.00 Protection during Construction**

Precautions shall be taken during the erection of the roof decking to ensure that partially erected decking are protected during inclement weather and damage at all times.

**3.04.00 Damage**

Any damage to coating & primer during transportation is to redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner.

**4.00.00 Acceptance Criteria**

The installation shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

a) Side and end laps

b) Absence of damage in the sheeting.

c) Conformity of fixings with the approved design.

**5.00.00 IS Codes**

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 513- Specification for cold rolled carbon steel sheets.

IS: 3618 - Specification for phosphate treatment of iron and steel for protection against corrosion.

IS: 4431 - Specification for carbon & carbon manganese free cutting steel.

IS: 1573 - Electroplated Coatings of zinc on iron and steel.

## 6.00.0 RATES AND MEASUREMENTS

### 6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include all wastage.

### 6.02.00 Method of Measurement

Roofing shall be measured for net area of the work done. Profiled sheeting (coated & painted) shall be measured in plan area of sheets and not girthed. No deduction shall be made for openings measuring up to 0.1 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.

No payments shall be made for laps.

| | TITLE: | |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR FALSE FLOORING** | SPECIFICATION NO. PE-TS-999-600-C020<br>VOLUME - II B<br>SECTION - D \| SUB-SECTION – D20<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 1 OF 6 |

# VOLUME: II B

## SECTION - D

### SUB-SECTION – D20

### FALSE FLOORING

## SPECIFICATION NO. PE-TS-999-600-C020

Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C020 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR FALSE FLOORING** | VOLUME - II B |
| | | SECTION - D \| SUB-SECTION – D20 |
| | | REV.NO. 00 DATE 03/10/2017 |
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# C 0 N T E N T


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| 6.00.00 | RATES AND MEASUREMENTS | 6 |

# FALSE FLOORING

## 1.00.00 General

This section of the specification covers the supply, fabrication and installation of false flooring system having PVC top finish particle board, GI supporting system, painting etc. as per schedule of items in the main plant building and any other area as indicated in the drawings.

The scope of contractor covers supplies of all materials, fabrication & installation works required to be carried out for completion of false flooring in the area specified in the drawings.

## 2.00.00 MATERIAL

### 2.01.00 Supporting structure

Supporting pedestals shall be made of steel and will be of height as required. Supporting pedestal shall be truly vertical and located at distances to conform with size of floor panels and shall be equipped with locking devices to prevent disturbances of finished elevation. Base of pedestal shall have integral load dispersion plate of size 100x100x8mm to transmit the load evenly to the base floor. Adjustment of pedestal shall be provided by threaded vertical rod of 25mm diameter and elevating nut. The pedestal head shall provide positive interlocking of the steel grid channels supporting system and shall prevent lateral shifting.

The grid channels shall be made of galvanised steel of 40mm x 40mm x 3.15mm thick and shall be placed at 610mm centre to centre both ways to support floor panels in uniform levelled elevations. Nominal height of the false flooring system shall be 600 mm unless otherwise indicated. Pedestal head shall be equipped with conducting grounding pad if so desired by the Engineer

### 2.02.00 Floor Panels

The floor panels shall be made of fire resistant particle board, phenol formaldehyde bonded. Size of each panel shall be 610mm x 610mm with all panel edges finished to a tolerance of + 0.2mm. Floor panel shall have 2mm thick non-static PVC on top, 2mm thick hard PVC strip lipping on four edges and 26 G aluminium sheet fixed with araldite at bottom. Minimum thickness of the panel shall be 35mm, unless otherwise noted. All panels shall be completely interchangeable and easily removable with a suction lift tool. Panels shall be square within a tolerance of $\pm$ 0.25 mm on the diagonal. The floor panels shall be cut, wherever required for providing suitable outlets for cables and edges shall be lipped with hard PVC sheets.

**2.02.01 Strength**

Each 610mm x 610 mm floor panel must be capable of withstanding the designed service load. The ultimate strength shall provide a safety factor of 3. The false flooring shall be capable of carrying a axial load of 800 kg and uniform load of 2000 kg/sq.m with maximum deflection of 1/350. If required by the Engineer, the samples shall be accepted only after carrying out load tests. The Engineer may relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement.

One additional pedestal shall be provided under floor stringer along front panel area of each control board for taking possible additional load that may occur from time to time.

**2.02.02 Surface finish**

All removable panels shall have the top surface finished with 2 mm thick flexible PVC flooring conforming to IS:3462 and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC floor tile shall be in single piece for each floor panel. Under side of panels shall also be painted with suitable epoxy or oil based paint.

**2.02.03 Damaged Floor Panels**

Distorted, blemished or stained floor panels shall not be used.

**2.03.00 Skirting**

Skirting shall be 150 mm high and 2 mm thick, completely matching with false flooring surface finish materials and shall be fixed to the wall surface as per manufacturer's installation instructions.

**3.00.00 INSTALLATION**

**3.01.00 Base**

The system shall be placed over a base of RCC floor slab and beams. Any grouting etc. that is necessary to fix the supporting structure shall be done.

The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture from coming in contact with cables and to minimize dust problem.

The floor panels and channels shall be completely interchangeable and remain in position without screwing or bolting under working/imposed loadings.

Any damage to the sub floor during installation of the false flooring system

shall be made good by the contractor without any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible primer and any damage to the paint during installation shall be made good. In case the loads exerted by the weight of machines are above the stated characteristics of floor finish material, the floor shall be protected by overlaying hard board during installation of machine or equipment.

All installation work of the false flooring system shall be supervised by the manufacturer's authorized representative.

**3.03.00 Painting**

After fixing the false flooring supporting system the sub floor shall be given a coat of polyurethane paint.

**3.04.00 Protection during Construction**

All precautions shall be taken during the erection of the false flooring to ensure that partially erected flooring are protected and shall not be damaged before handing over to owner.

**3.05.00 Damage**

Any damage of coating to supporting system caused during transportation is to be redone with the similar type of coating as per the manufacturer’s specification at no extra cost to the Owner.

**4.00.00 ACCEPTANCE CRITERIA**

The false flooring system shall only be accepted after completion of following checks:

a. Level

b. Alignment of joints

c. Thickness of joints

d. Surface finish

e. Colour and texture

f. Details of edges, junctions etc.

g. Performance

h. Criteria specified for strength.

## 5.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS:5318 Laying of flexible sheet and flooring.

IS:3462 Flexible PVC flooring

IS:3087 Wood particle boards (medium density) for general purposes.

## 6.00.0 RATES AND MEASUREMENTS

### 6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include, but not limited to, supply & installation of floor panels, supporting systems, paintings etc.

### 6.02.00 Method of Measurement

False flooring shall be measured in Sq.M for net area of the work done. No deduction shall be made for openings measuring up to 0.4 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.

# VOLUME: II B

## SECTION - D

## SUB-SECTION – D21

## BORED CAST-IN-SITU RCC PILES

## SPECIFICATION NO. PE-TS-999-600-C021


**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

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# TECHNICAL SPECIFICATION FOR INSTALLATION OF BORED CAST-IN-SITU PILES

## 1.00.00 SCOPE

This specification covers the installation of bored cast-in-situ reinforced concrete vertical piles of specified load carrying capacity and diameter for various structures. This specification also covers carrying out initial and routine load tests on piles to assess their vertical, horizontal and pull out load carrying capacities.

## 2.00.00 GENERAL REQUIREMENTS

2.01.00 This specification along with specific requirements under Annexure-A covers the technical requirements for piling work.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments (Annexure-B), providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carry out the complete piling work, and submission of records as per schedule.

2.03.00 The Contractor shall carryout all works as mentioned in Scope above. All works shall be executed to the satisfaction of the Engineer.

2.04.00 Pile capacities in vertical compression, horizontal, pull-out loads for various pile diameters are given in Annexure-A.

2.05.00 The Contractor shall confirm and guarantee the "Safe Load" capacities by conducting both initial and working load test on piles as mentioned in the specific requirements.

2.06.00 The Contractor shall submit along with tender documents his tender design of piles based on soil data furnished by the Owner along with this specification. The ultimate load capacity of a pile may be estimated using suitable static formula and the minimum factor of safety shall be 2.5. However, safe load carrying capacity shall be conformed and guaranteed by conducting initial and routine load tests.

2.07.00 In case of initial or routine load test piles, if the Contractor fails to establish the safe load capacity as per his design, the Owner has the right to either derate the pile capacity on prorata basis or insist the Contractor to modify the pile design, to achieve the desired safe load capacity at no extra cost to the Owner.

2.08.00 Derating is acceptable up to 90 percent. In such case, additional piles shall be installed as per the design requirements.

2.09.00 The Owner shall decide whether to derate or modify the design based on the design considerations such as providing additional piles in the designed pile cap, provision for extending the pile cap size, etc.

2.10.00 In case the Owner decides to modify the design instead of derating the pile, the contractor shall carry out the same and install separate test piles and test the same to guarantee the safe load at no extra cost to the Owner. However, no extra shall be charged for the additional test piles as well as testing of these piles as per agreed contract conditions.

2.11.00 In case of working piles, if the pile does not meet the guaranteed capacity or rejected due to any other reason, the Contractor shall install extra piles at no extra cost to the Owner. Further, the extra cost, due to the increase in the pile cap size if any, on account of extra piles, shall be borne by the Contractor.

2.12.00 It is essential that all equipment and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values. Certificates to this effect from an approved institution shall be furnished to the Engineer. If the Engineer so desires the Contractor shall arrange for having the instruments tested at an approved laboratory at no extra cost to the Owner and the test report shall be submitted to the Engineer. If the Engineer desires to witness such tests Contractor shall arrange to conduct the test in his presence.

2.13.00 The Contractor shall make his own arrangements for locating the coordinates and position of piles as per drawings supplied to him and for determining the Reduced Levels (RL) of these locations with respect to the benchmark indicated by the Engineer. Two established reference lines in mutually perpendicular direction shall be indicated to the Contractor. The Contractor shall provide at site all the required survey instruments to the satisfaction of the Engineer so that the work can be carried out accurately according to specifications and drawings.

2.14.00 The contractor shall assure the quality of piling work including cleaning of pile bore, quality of concrete, integrity of piles, etc.

2.15.00 **AVAILABLE SUB-SOIL DATA**

An abstract of the sub soil data is furnished in the tender document. However, the detailed soil investigation report shall be made available for reference of the bidder, if so required, at the office of the Owner. The soil data furnished is in good faith and only for the guidance of the Bidder, to arrive at design parameters and construction methods.

## 3.00.00 MATERIALS

### 3.01.00 General

All materials viz cement, steel, aggregates, water, etc. which are to be used for pile construction shall conform to relevant IS codes for properties, storage and handling of common building materials. However, aggregates more than 20 mm size shall not be used.

### 3.02.00 CONCRETE

Concrete shall be manufactured either by central batching plant or Ready Mix concrete. However, for initial test piles suitable method as approved by the Engineer may be used. Concrete shall conform to IS: 10262 & IS: 456.

3.02.01 Technical Specification for Cement Concrete (Plain and Reinforced) works along with IS: 2911 Part I/Sec 2 shall be followed for concrete works of piles. Use of plasticiser to control the water cement ratio shall be permitted on specific approval from the Engineer. Water cement ratio shall not be greater than 0.5.

3.02.02 Grade and minimum cement content
Minimum grade of concrete shall be as per Annexure-A conforming to IS: 456. Minimum cement content of 400 Kg/M$^3$ of concrete shall be used for M-20 grade concrete.

3.02.03 Slump of concrete
The slump of concrete shall vary between 150 to 180 mm.

### 3.03.00 REINFORCEMENT

3.03.01 Longitudinal reinforcement in pile shall be high strength deformed steel bars conforming to IS: 1786 unless specified otherwise. Lateral reinforcement in pile shall be of mild steel conforming to IS: 432 Part-1 or HYSD bars as per IS: 1786.

3.03.02 The longitudinal reinforcement shall be provided considering the combination of vertical (compression and tension) and horizontal loads. However, the minimum longitudinal reinforcement shall be 0.4 percent of the sectional area calculated on the basis of nominal pile diameter. Minimum six numbers of bars shall be provided for longitudinal reinforcement. The diameter of longitudinal reinforcement bars shall not be less than 12mm. The stipulated minimum reinforcement shall be provided for the full length of pile.

3.03.03 The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.

3.03.04 The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing. The laterals may in the form of links or spirals. The minimum diameter of the links or spirals shall be 6 mm and the spacing of the links or spiral shall not be less than 150 mm and in no case more than 250 mm.

3.03.05 Reinforcement cage shall be sufficiently rigid to withstand handling and installation without any deformation and damage. As far as possible number of joints (laps) in longitudinal reinforcement shall be minimum. In case the reinforcement cage is made up of more than one segment, these shall preferably be assembled before lowering into casing tube/pilebore by providing necessary laps as per IS: 456.

3.03.06 The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage.

3.03.07 The laps in the reinforcement shall be such that the full strength of the bar is effective across the joint and the reinforcement cage is of sound construction.

3.03.08 Laps shall be staggered as far as practicable and not more than 50% bars shall be lapped at a 'particular section. Lap joints shall be staggered by at least 1.3 times the lapped length (Centre to Centre).

3.03.09 Proper cover and central placement of the reinforcement cage in the pile bore shall be ensured by use of suitable concrete spacers or rollers, cast specifically for the purpose.

3.03.10 Minimum clear cover to the longitudinal reinforcement shall be 50 mm, unless otherwise mentioned.

3.03.11 Bundling of bars is not permitted.

## 4.00.00 PILE INSTALLATION

Installation of piles shall be carried out as per pile layout drawings, installation criteria, and the direction of the Engineer.

### 4.01.00 Equipment and Accessories

4.01.01 The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the sub soil conditions, ground water conditions and the method of casting, etc. These shall be of standard type and shall have the approval of the Engineer.

4.01.02 List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.

4.01.03 The capacity of the rig shall be adequate so as to reach the specified founding level.

4.01.04 Provision shall be kept for chiselling within the pilebore, as specified elsewhere in this specification. Chiselling shall be carried out only with the approval of Engineer.

**4.02.00 Installation Criteria**

4.02.01 For determining the founding level of piles in soil as specified elsewhere, the Contractor shall have to perform Standard penetration test (SPT) as per IS: 2131 in a separate bore hole. The SPT shall be conducted at 1.0 m interval between the depths covering 5 metres each above and below the specified founding level. The bore shall be 100 mm diameter and method of boring shall conform to IS: 1892.

4.02.02 For determining founding level of piles in rock, as specified elsewhere socketing horizon shall be established by the Contractor by collecting rock cores of NX size in a separate borehole, and testing the same for uniaxial compressive strength (UCS). Cores shall be collected by double tube core barrel attached with diamond bit. Coring shall be done upto a depth as indicated in the "specific requirements." Coring in rock shall conform to IS: 6926.

4.02.03 In case it is not possible to test the cores so obtained for uniaxial compressive strength, cores shall be tested for point load strength index and correlated to obtain uniaxial compressive strength.

4.02.04 Number of boreholes for carrying out SPT in soil or uniaxial compressive strength in rock, shall vary from one in 100 to 150 piles or pile group of 150 Sqm depending on the site condition and as decided by the Engineer. However, at the location of initial load test piles, one such borehole shall be done.

4.02.05 A protocol between contractor and BHEL site shall be maintained regarding the strata at founding level. SPT value and UCS from the nearest borehole shall be indicated therein.

4.02.06 The founding level of the pile shall be decided based on the criteria elaborated in the specific requirements under Annexure-A. Concreting shall not be done until the above conditions for founding level are satisfied.

4.02.07 Approval of founding level by the Engineer shall in no way absolve the Contractor of his responsibility to guarantee the Safe load capacity of the piles as indicated in this document.

**4.03.00 Control of position and alignment**

4.03.01 Piles shall be installed as accurately vertical as possible. The permissible limits for deviation with respect to position and (inclination) alignment shall conform to IS: 2911 Part I/Sec. 2, which is reproduced below for ready reference.

a) The maximum deviation of vertical piles shall not exceed 1.5 per cent in alignment.

b) Piles shall not deviate more than 75 mm or D/4 whichever is less (75mm or D/10 whichever is more in case of piles having diameter more then 750mm) from their designed position at the working level.

**4.04.00 Boring**

4.04.01 Boring operations shall be done by rotary or percussion type drilling rigs using reverse mud circulation (RMC) method. Rotary hydraulic pulley shall be preferred.

4.04.02 The Contractor shall satisfy himself about the suitability of the method to be adopted for site. If DMC (direct mud circulation) or RMC is used Bentonite slurry shall be pumped through drill rods by means of high-pressure pumps. The cutting tool shall have suitable ports for the bentonite slurry to flow out at high pressure. If on mobilisation, the Contractor fails to make a proper bore for any reason, the Contractor has to switchover to other boring methods as approved by the Engineer at no extra cost to the Owner.

4.04.03 Working level shall be above the cut off level. After the initial boring of about 1.0m a temporary guide casing of suitable length shall be lowered in the pile bore. The diameter of guide casing shall be of such diameter, so as to give the necessary finished diameter of the concrete pile. The centre line of guide casing shall be checked before continuing further boring. Guide casing shall be minimum of 1.0m length. Additional length of casing may be used depending on the condition of the strata, ground water level etc.

4.04.04 Use of drilling mud (bentonite slurry) for stabilizing the sides of the pile bore is necessary wherever subsoil is likely to collapse in the pile bore. Drilling mud to be used shall meet the requirement as given in Annexure-C.

4.04.05 The bentonite slurry and the cuttings, which are carried to the surface by the rising flow of the slurry, shall pass through settling tanks of adequate size to remove the sand and spoils from the slurry before the slurry is recirculated to the boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.

4.04.06 The bentonite slurry shall be maintained at 1.5m above the ground water level during boring operations and till the pile is concreted. When DMC or RMC

method is used the bentonite slurry shall be under constant circulation till start of concreting.

4.04.07 The size of cutting tools shall not be less than the diameter of the pile by more than 75mm. However, the pile bore shall be of the specified size.

**4.05.00 Chiselling**

4.05.01 Chiselling may be resorted to with the permission of the Engineer below the socketing horizon. The chiselling tool or bit shall be of adequate size and weight so as to reach the desired depth.

**4.06.00 Cleaning of Pile bore**

4.06.01 On completion of the pile bore upto the required depth, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning shall ensure that the pile bore is completely free from sludge/bored materials, debris of rock/boulder etc. Necessary checks shall be made as given in clause 5.0 to confirm the thorough cleaning of the pile bore.

4.06.02 Pile bore shall be cleaned by fresh drilling mud through tremie pipe after placing reinforcement and just before start of concreting.

4.06.03 Pile bore spoil along with used drilling mud shall be disposed off from site as directed by the Engineer.

4.06.04 Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.

**4.07.00 Adjacent Structures**

4.07.01 When working near existing structures care shall be taken to avoid any damage to such structures.

**4.08.00 Concreting**

4.08.01 The Contractor shall carry out concrete mix design in accordance with IS: 10262 and submit mix design calculations and get them approved from the Engineer well in advance for installation of piles. Adequate number of tests on cubes, etc. shall be carried out as mentioned in clause 5.0 to ensure concrete of the minimum specified strength in accordance with IS: 456 at requisite workability (slump).

4.08.02 Concreting shall not be done until the Engineer is satisfied that the bearing strata (soil/rock) met with at the termination level of pile.

4.08.03 The time interval between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceeds 6 hrs the pilebore shall be abandoned. However, the Engineer may allow concreting provided the Contractor extends the pile bore by 0.5 m beyond the proposed depth, and clean the pilebore. The entire cost of all operation and materials for this extra length shall be borne by the Contractor.

4.08.04 Proper placement of the reinforcement cage to its full length shall be ensured before concreting.

4.08.05 Concreting shall be done by tremie method as specified by IS: 2911 (Part I /Sec.2). The level of drilling mud shall be maintained sufficiently above the ground water level.

4.08.06 The concreting operations shall not be taken up when the specific gravity of bottom slurry is more than 1.2 and sand content more than 7%. The drilling mud sample shall be collected from the bottom of pilebore as mentioned in clause 5.

4.08.07 Consistency of the drilling mud suspension shall be controlled throughout the concreting operations in order to keep the bore stabilized as well as to prevent concrete getting mixed up with the thicker suspension of the mud.

4.08.08 It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast.

4.08.09 The temporary guide casing shall be withdrawn cautiously, after concreting is done upto the required level. While withdrawing the casing concrete shall not be disturbed.

**4.09.00 Cut off level (COL)**

4.09.01 Cut off level of piles shall be as indicated in drawings released for construction or as indicated by the Engineer.

4.09.02 The top of concrete in pile shall be brought above the COL to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedment in to pile cap.

4.09.03 When the pile cut off level is less than 1.0 metre below the working level, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 metre below working level then concrete shall be cast to a minimum of one metre above COL.

**4.10.00 Sequence of Piling**

4.10.01 Each pile shall be identified with a reference number.

4.10.02 The convenience of installation may be taken into account while scheduling the sequence of piling in a group. This scheduling shall avoid piles being bored close to other recently constructed piles.

**4.11.00 Building up of Piles**

4.11.01 If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut off level or the cast pile top level is less than the specified level or for any other reason, then the pile shall be built-up by using atleast one grade higher concrete than that used for concreting of the same pile, ensuring proper continuity with the existing concrete and to the satisfaction of the Engineer. Necessary reinforcement as per design requirement and suitable shuttering shall be provided before casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction to ensure lateral capacity of the pile.

**4.12.00 Breaking off of Piles**

4.12.01 If any pile already cast, requires breaking due to lowering in cut off level or for any other reason, then the same shall be carried out, not before seven days of casting without affecting the quality of existing pile such as loosening, cracking etc. and to the satisfaction of the Engineer.

**4.13.00 Preparation of Pile head**

4.13.01 The soil surrounding the piles shall be excavated upto the bottom of the lean concrete below the pile cap, with provision for working space, sufficient enough to place shuttering, reinforcement, concreting and any other related operations.

4.13.02 The exposed part of concrete above the COL shall be removed/chipped off and made to a uniform level at COL, but not before seven days of casting of pile.

4.13.03 The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap.

4.13.04 The pile top shall be embedded into the pile cap by 50mm or clear cover to reinforcement, whichever is higher.

4.13.05 All loose material, like debris due to chipping/breaking of pile head to the desired level, shall be removed and disposed off as directed by the Engineer.

**4.14.00 Rejection and Replacement of Defective Piles**

4.14.01 The Engineer reserves the right to reject any pile which in his opinion is defective on account of load capacity, structural integrity, position, alignment, concrete quality etc. Piles that are defective shall be pulled out or left in place as judged convenient by the Engineer, without affecting the performance of adjacent piles. The Contractor shall install additional piles to substitute the defective piles as per the directions of the Engineer, at no extra cost to the Owner.

**4.15.00 Recording of Piling Data**

4.15.01 The Contractor shall record all the information during installation of piles. Typical data sheet for recording pile data shall be as shown in Appendix D of IS: 2911 Part I/Sec.2. The pile data shall also include all the details as in Annexure-D. On completion of each pile installation, pile record in triplicate shall be submitted to Engineer within two days of completion of concreting of the pile.

**5.00.00 SAMPLING, TESTING AND QUALITY ASSURANCE**

5.01.00 Facilities required for sampling and testing of materials, concrete, etc. in field and in laboratory should be provided by the Contractor. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and this Specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the Contractor shall arrange to get these tests done and submit to the Engineer the test results in triplicate within three days after completion of any test.

5.02.00 The Contractor shall maintain records of all inspection and testing, which shall be made available to the Engineer. The Engineer at his discretion may waive some of the stipulations for small and unimportant concreting operations and other works.

5.03.00 Materials found unsuitable for acceptance shall be removed and replaced by the Contractor. The work done by this unsuitable material shell be redone as per specification requirements & and to the satisfaction of the Engineer at no extra cost to the Owner.

**5.04.00 Quality Assurance Programme**

a) The Contractor shall submit and finalize a detailed Field Quality Assurance Programme within 30 days from the date of award of the contract, according to the requirements of this specification. This shall include setting

up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results.

b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table - 1. The testing shall be done at field laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications.

**5.05.00 Testing of Concrete**

5.05.01 Concrete and other materials shall be tested for quality, strength and other properties. Details of testing shall be as specified under technical specification for Cement concrete (Plain and Reinforced).

5.05.02 One sample consisting of six test cubes shall be made from the concrete used in each test pile, three to be tested after 7 days and three after 28 days.

5.05.03 For working piles, minimum one sample consisting of six test cubes shall be made from the concrete for the first ten piles, three to be tested after 7 days and three after 28 days. Thereafter, minimum one sample consisting of three test cubes for every 10 piles shall be tested for the 7-days & 28-days cube strength.

5.05.04 In preparation of test cubes or specimen's vibrators shall not be used.

5.05.05 Concrete shall be tested for slump at every 1-hour interval during concreting of piles.

5.05.06 The frequency of sampling and testing of concrete and materials shall be done as per technical specification for cement concrete (Plain & Reinforced).

5.05.07 The acceptance criteria shall be as mentioned in Table-1.

**5.06.00 Testing for position and alignment**

5.06.01 Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment.

5.06.02 Permissible limits for deviation shall be as specified under clause no. 4.03.

**5.07.00 Properties of Drilling mud**

5.07.01 Properties of drilling mud shall be checked as per requirement under Annexure C. Prior to the commencement of piling work and thereafter minimum once in a week or as found necessary by the Engineer, one sample consisting of 3 specimens shall be tested. Acceptance criteria applicable are as specified elsewhere with 5% variation. This relaxation is not applicable for properties of drilling mud before concreting.

5.07.02 Density of the drilling mud shall be checked in each pile before concreting.

**5.08.00 Check for Pile bore**

5.08.01 On completion of boring and cleaning the bottom of each pilebore shall be checked from the sample collected from near the bottom of pile bore or by any other methods as approved by the Engineer, to ensure that it is free from pilebore spoil/debris and any other loose material, before concreting. Concreting shall be done only after the approval of the Engineer.

5.08.02 For sampling of drilling mud from the pilebore the following method or any other suitable method shall be adopted.

a) A solid cone shall be lowered by a string to the bottom of pilebore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, and then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimize the leakage while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density and sand content.

b) Use of borehole camera for checking the pile bore spoil and strata is acceptable on approval of the Engineer.

**5.09.00 Pile Integrity test**

5.09.01 Low strain integrity test shall be conducted on 50% of the jobs piles and on all test piles or as directed by Engineer. The system shall have the computer readout facility and report on the findings of this shall be furnished to the Owner. This test shall be used to identify the job piles for routine load test.

Piles shall be trimmed to cut off level or sound concrete level. No pile cap blindage work should be undertaken prior to this test. The cast in-situ piles should not be tested before 14 days of casting.

5.09.02 The test shall be undertaken by persons trained and experienced and capable of interpreting the results with specific regard to piling. This test is limited to

testing the integrity of the shaft and is not intended to replace the use of static load testing.

5.09.03 Low Strain Integrity Test Methodology:

a) In this test, a low stress wave is set up in the pile shaft and is also known as Sonic Integrity or Sonic Echo test.

b) A small metal/hard rubber hammer is used to produce a light blow on top of the pile. The shock wave travelling down the length of the pile is reflected back from the toe of the pile and recorded through a suitable transducer/ accelerometer in a computer for subsequent analysis.

c) The primary shockwave, which travels down the length of the shaft, is reflected from the toe by the change in density between the concrete and sub strata. However, if the pile has any imperfections or discontinuities within its length these will set up secondary reflections, which will be added to the return signal.

d) By analysis of the captured signal and knowledge of the conditions of the ground, age of concrete, etc. a picture of the locations of pile shaft defects can be built up. The observed signals are amplified into digital display as velocity versus length records providing information on structural integrity of piles.

e) The stress wave velocity and approximate pile lengths are provided as input for the integrity testing. The stress wave velocity is dependent on the Young's Modulus and mass density of pile concrete.

f) More than one recording of signals shall be done until repeatability of signals is achieved on the same pile.

g) The tests shall be conducted at 3-6 locations to cover the entire cross section of the pile.

## 6.00.00 PILE TESTING

Pile load test shall be carried out as per IS:2911 Part-4 (latest edition) or as directed by Engineer.

## 6.01.00 INITIAL LOAD TEST

Initial load test shall be carried out on separately cast piles for confirmation of estimated pile capacities and to fix a more accurate driving criteria viz. set/bow, total number of blows and approximate depth etc. of founding level. At least 2 nos. of tests shall be conducted for each mode (vertical compression, pull out and lateral). The maximum test load shall be as

mentioned in bill of quantities.

## 6.02.00 ROUTINE LOAD TEST

Routine load tests shall be carried out on job (working) piles for 0.5% of total no. of piles (for each mode and type). Maximum test load shall be 1.5 times the design safe load capacity. Piles showing unsatisfactory results as per load test results shall be treated as defective piles. Defective piles shall be removed or left in place and replaced by additional piles as directed by Engineer at no extra cost to the owner. Any additional cost towards design implications, if any, due to above shall be borne by the contractor.

## 7.00.00 CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

| | | |
|---|---|---|
| IS: 432 (Part 1 & 11) | - | Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement. |
| IS: 456 | - | Code of practice for plain and reinforced concrete. |
| IS: 1200 (Part 23) | - | Measurement of Building and Civil Engineering works Piling. |
| IS: 1786 | - | Code of practice for twisted steel high strength deformed bars for concrete reinforcement. |
| IS: 1892 | - | Code of practice for Subsurface Investigation for foundation. |
| IS: 2131 | - | Method of Standard Penetration Test for Soils |
| IS: 2911 Part I/Sec 2 | - | Code of practice for design and construction of pile foundations - Bored cast-in-situ concrete piles. |
| IS: 2911 Part IV | - | Code of practice for design and construction of pile foundation - Load test on piles. |
| IS: 6926 | - | Code of practice for Diamond Core Drilling for Site Investigation for River Valley Projects. |
| IS: 10262 | - | Recommended guidelines for concrete mix design. |

## 8.00.00 RATES AND MEASUREMENTS

The clauses below shall apply for item rate contracts only. They shall not be applicable to turnkey/lump sum Contracts.

### 8.01.00 Rates

8.01.01 The items of work in the schedule of items, describe the work in brief. The various items in schedule of items shall be read in conjunction with the corresponding sections in the Technical Specifications, including amendments, and additions, if any. For each item in schedule of items, the unit rate shall include for the activities covered in the description of the item as well as for all necessary operations described in the specification and specific requirements.

8.01.02 The unit rates shall include for minor details which are obviously and fairly intended, and which may not have been included in the description in these documents, but are essential for the satisfactory completion of the work. Unit rates shall also include for all safety measures as required by codal provisions, local regulations, acts, bye-laws, etc. and for execution of work to the satisfaction of the Engineer.

8.01.03 The quoted rate for each item shall be inclusive of mobilization of all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilization after completion of work, supervision, establishing the level and coordinates at each work.

8.01.04 The quoted rate for piling for a particular diameter and capacity of pile shall remain valid for the actual lengths provided /to be provided irrespective of the minimum length specified elsewhere in this specification.

8.01.05 The quoted rate for piling as per description of item works shall be inclusive of providing all plant equipment, labour, materials, skilled and unskilled labour, making observations, establishing the ground level and coordinates at each location of pile by carrying levels from one established bench mark and distances from one set of grid lines furnished by the owner.

8.01.06 The quoted rate for piling shall be inclusive of bailing out all the pile bore spoil from the pilebore, keeping the borehole free from bored material/debris etc. and disposing the bored/chiselled material along with the drilling mud upto 2 Km. beyond plant boundary or as directed by Engineer, flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of pilebore, transporting to laboratory, testing and reporting of results.

8.01.07 The quoted rate for piling shall include shifting of plant and equipment from one pile location to another pile location, providing temporary casing pipe and removal of the same after completing, concreting, supply of necessary materials,

equipment and manpower, cost of boring by approved method as specified, circulation of bentonite slurry and cleaning of borehole free from sludge, as specified, etc.

8.01.08 The quoted rate for piling shall also include chiselling, if any, required for socketing the pile in rock.

8.01.09 The quoted rate for the piling shall include concreting by termite method, length of pile above COL, withdrawal of guide casing, cost for preparation of pile head and disposal of debris etc., resulting from breaking off of pile upto COL, upto a distance of 2 Km from the plant boundary or as directed by Engineer.

8.01.10 The quoted rate for piling shall also include providing reinforcement and its cleaning, straightening, cutting, bending, binding with annealed wire, welding, tack welding, providing concrete cover blocks, spacers, placing the reinforcement cage in pile casing/bore and other cost of tools and plants, materials, labours, carting the steel from store to piling site and return of unused steel to the Owners storage point, etc.

8.02.11 Plasticiser/Admixture when used as directed by the Engineer shall be included in piling rates.

8.01.12 The quoted rate for piling shall include for all quality assurance requirements, but not limited to providing for technical inspection, transportation of samples to laboratory, testing samples, maintaining and submitting all test records, etc.

8.01.13 The quoted rate for boring in separate borehole shall be inclusive of performing of SPT at regular intervals as specified and collecting rock cores from boreholes, upto the depth as specified shall be inclusive of transporting to laboratory, testing and reporting of the results.

8.01.14 Unit rate for low integrity test shall be inclusive of mobilization of the entire set of equipment, computer readout, printer, and equipment which may not lave been included in the description but are essential for the satisfactory completion of the work as per internationally accepted practice. The rate quoted shall be inclusive of repeatability of test, preparation of pile top surface etc.

**8.02.00 Measurement**

8.02.01 Piling length shall be measurement by linear measurement from pile cut-off level to the tip of pile in meters upto second place of decimal separately for each diameter and capacity of pile. The length of pile to be cast above cut off level, as per specification, and as approved by Engineer, shall be considered for cement reconciliation only. Theoretical diameter of piles shall be

considered for reconciliation of cement consumption. No extra payment shall be made for the length from existing ground to cut-off level.

8.02.02 Reinforcement steel shall be measured for reconciliation purpose only and the measurement shall be done for providing and placing reinforcement in piles, by weight in tones, up to third place of decimal in the following manner:

i) The weight shall be arrived at by multiplying the actual length measured along with standard hooks, rings or spirals, spacers, cranks, bends, authorized laps, etc. by sectional weight. These shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS code's sectional weight. Nothing extra shall be payable to the contractor on account of difference in weight, if any, due to different methods adopted for issue and measurement.

ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones.

iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured.

8.02.03 Breaking off of piles, due to subsequent change in design cut off level, shall be measured separately. This shall be measured in cubic metres upto second place of decimal. This will be payable only when the pile is cast and on the basis of written instruction of the Engineer for lowering of COL.

8.02.04 Measurements for the item of boring in a separate borehole shall be measured in metres from ground level upto the depth as specified, upto second place of decimal. Item of work of boring in soil and coring in rock shall be measured separately for the actual length of boring in soil and coring in rock.

8.02.05 The item for pile integrity test shall be measured in terms of no. of piles tested.

**ANNEXURE-A**

## Specific Requirements for Bored Cast-in-situ RCC Piles

Al.0 Minimum cement concrete grade M-25

Minimum cement content 400 Kg/M³

A1.1 Safe load

Diameter of Pile

| Diameter of Pile (mm) | Vertical/ Compression (MT) | **Horizontal/ Lateral (MX)** | **Pul lout/Tension (MT)** |
|---|---|---|---|
| * | * | * | * |
| * | * | * | * |

A2. Installation criteria

The installed pile(s) shall satisfy the following criteria.

A2.1 In Soil/weathered Rock

a) Minimum length of the pile shall be _____* m below COL.

b) The pile shall be terminated after penetrating through the strata having SPT penetration less than __* cm for ____* blows, for a minimum length of _____* times the diameter of the pile.

A2.2 In Rock

a) Piles shall be installed and socketed into the rocks for a length (socketing length) equal to _____* times the pile diameter subject to a minimum of _____* meter below the socketing horizon.

b) Socketing horizon shall consist of rock strata having minimum uniaxial compressive strength of _____* kg/sq.cm.

A3. Average cut-off level for tender design and initial load test can be assumed as _____* m below ground level.

A4. A protocol shall be signed between BHEL site and contractor regarding,

Strata at the founding depth

Installation criteria

Socketing depth

Density of bentonite before concreting

Slump of concrete.

Time interval between end of boring and start of concreting,

* Values shall be indicated separately depending upon subsoil strata of the site.

## ANNEXURE-B

# List of Equipments

| S. No | Description | Capacity No. |
|---|---|---|
| 1. | Piling Rigs | |
| 2. | Chisel | 3 T min<br>6 T max |
| 3. | High pressure Mud Pumps | 10 HP min<br>25 HP max |
| 4. | Bentonite mixing plants | |
| 5. | Concrete batching plant | |
| 6. | Soil testing equipments | |

**Note:**

1. The no. and capacity of the piling equipment varies for each work.
2. Additional equipments shall be mobilized if required as per the directions of the Engineer to match the work schedule at no extra cost to the Owner.

## ANNEXURE-C

Bentonite suspension used for piling work shall satisfy the following requirements

a) Liquid limit of bentonite when tested in accordance with IS: 2720(Part V) shall be more than 300 percent and less than 450 percent.

b) Sand content of the bentonite powder shall not be greater than 7 percent.

c) Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the freshly prepared bentonite suspension shall be between 1.034 and 1.10 gm/ml depending upon the pile dimensions and type of soil in which the pile is to be installed. However, the density of bentonite suspension after mixing with deleterious materials in the pilebore may be upto 1.25 gm/ml.

d) The Marsh viscosity when tested by a Marsh cone shall be between 30 to 60 seconds.

e) The differential free swell shall be more than 540 percent.

f) The pH value of the bentonite suspension shall be between 9 and 11.5.

## ANNEXURE-D

PILE DATA

1. Reference No. Location (Co-ordinates) _____area.
2. Sequence of Piling
3. Pile diameter & Type
4. Working level (Platform level)
5. Cut off level (COL)
6. Actual length below COL
7. Pile termination level
8. Top of finished concrete level
9. Date and time of start and completion of boring.
10. Depth of Ground water table in the vicinity.
11. Type of soil at pile tip
12. Method of boring operation
13. Details of drilling mud as used:

    i) Freshly supplied mud
    Liquid limit -

    Sand content -

    Density -

    Marsh viscosity -

    Swelling index -

    pH value -

    ii) Contaminated mud
    Density -

    Sand content -

14. SPT* N values in soil (from the nearest bore hole).
+UCS** value in rock (from the nearest bore hole).

* Standard penetration Test
** Unconfined compression strength

15. Chiselling if any, from..….. m to ….... m

16. Date and time of start and completion of concreting.

17. Method of placing concrete

18. Concrete quantity
**Actual**

**Theoretical**

19. Ref. Number of test cubes

20. Grade and slump of concrete

21. Results of test cubes

22. Reinforcement details:

| | |
|---|---|
| Main Reinforcement | Stirrups: Type |
| No._____ | No._____ |
| Dia. _____ | Dia._____ |
| Depth _____ | Spacing _____ |

23. Any other information regarding obstructions, delay and other interruption to the sequence of work.

# TABLE -1

FREQUENCY OF SAMPLING AND TESTING

| SI. No | Type of material work | Nature of Test/ characteristics | Method of Test & frequency | No. of test | Acceptance Criteria |
|---|---|---|---|---|---|
| 1. | Pilebore size<br>a) diameter<br>b) length | | Physical measurement | each pile | as per specification |
| 2. | Founding level | to establish socketing horizon/ and or founding level & upto depth 5m below founding level. | in separate borehole meant for the purpose<br>a) SPT in soils/ weathered rock<br>b) Core & UCS value of rock | 1 borehole for 100-150 piles or group of 150 Sqm | Annexure - B |
| 3. | Bentonite (Mud) properties.<br>a) Basic properties of bentonite before use.<br>b) Contaminated mud from pile bore bottom before concreting | Liquid Limit, Marsh Viscosity, Specific gravity, sand content, swelling index, pH value.<br>Density, sand content | in lab<br>in lab | As per Cl. 5.7<br>Each Pile | As per Annexure C<br>As per annexure C |
| 4. | Position and Alignment | - | Physical or any Approved method | Each Pile | As per Cl. 4.3 |
| 5. | Cleaning of pilebore | - | As per Cl. 5.8 | Each Pile | Pilebore be free from bored material debris/sludge |
| 6. | Reinforcement (R/F) Spacing of longitudinal R/F cover laps binding of laterals | | Physical inspection and measurement | each cage | As per approved design |
| 7. | Concrete<br>a) Workability<br>b) Cubes | <br>Slump cone test<br>Compressive Strength test | <br>Each pile<br>As per spec. | <br>As per Cl. 5.5<br>As per Cl. 5.5 | <br>As per specification.<br>As per IS: 456 |
| 8. | Materials like aggregate, sand etc. | As per technical specification for concrete and relevant IS codes | | | |
| 9. | Pile head | | Physical | each pile | |

# VOLUME: II B

## SECTION - D

### SUB-SECTION – D22

# SITE LEVELLING & GRADING WORKS

## SPECIFICATION NO. PE-TS-999-600-C022


**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C022 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D22<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 2 OF 16 |

# C 0 N T E N T


| CLAUSE NO. | DESCRIPTION | SHEET NO. |
|---|---|---|
| 1.00.00 | GENERAL | 3 |
| 2.00.00 | SCOPE | 3 |
| 3.00.00 | MATERIALS | 4 |
| 4.00.00 | QUALITY CONTROL | 6 |
| 5.00.00 | EXECUTION | 6 |
| 6.00.00 | RATES AND MEASUREMENTS | 15 |

# GENERAL TECHNICAL SPECIFICATION FOR SITE LEVELLING AND GRADING

## 1.00 GENERAL

This specification covers the works to be carried out for **"Site Levelling and Grading Works including Slope Protection"** etc. for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be.

## 2.00 SCOPE

2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also includes supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc.

2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to Indian Standard (IS) codes or equivalent thereof.

### 2.03 Work to be provided by the Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision, services including as required under statutory labour regulations, materials, equipments, tools and plants, approaches, transportation etc. required for the completion of the work.

b) Preparation and submission of detailed scheme of all operations required for executing the work (material handling, placement, services, approaches etc.) to the engineer for approval.

c) Carrying out sampling and testing on fill materials/fills to assess the quality/moisture content/degree of compaction and submission of the test results whenever required by the engineer.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc.

**2.04 Work to be provided by others**

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

**2.05 Codes and Standards**

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) codes unless specified otherwise.

IS: 1200 Methods of measurement of building and civil engineering works, Part-1: Earthwork

IS: 2720 Method of test for soils (Relevant parts)

IS: 3764 Excavation work- Code of safety

IS: 4081 Safety code for blasting and related drilling operations

IS: 4701 Code of practice for earthwork on canals

IS: 6922 Criteria for safety and design of structures subject to underground Blasts

In case of conflict between this specification and those (IS codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by the specification or/and by the IS codes, any other standard practice as may be specified by the engineer shall be followed.

**2.06 Conformity with Designs**

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

**3.00 MATERIALS**

All materials required for the work shall be of best variety and approved by the engineer.

**3.01 Materials for Excavation**

For the purpose of identifying the various strata met during the course of excavation, the following classification is to be followed.

**a) Soil**

It includes all type of soil including laterite, moorum etc. with/without any percentage of kankar which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc. and those which do not fall under **clause** 3.01 (b) and (c) etc.

**b) Soft Rock**

It includes the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers or such implements etc. and not requiring blasting (for excavation) in the opinion of the engineer.

**c) Hard Rock**

It includes the rocks, which require blasting for excavation in the opinion of the engineer. Where blasting is prohibited for any reasons, the excavation shall be carried out by chiseling or any other method as approved by the engineer. The mere fact that the contractor resorts to blasting shall not classify the soft rock under hard rock.

**However, the engineer's decision on the type of strata encountered during excavation shall be the final and binding on the contractor.**

**3.02 Materials for Filling**

Any coarse grained or fine grained low plastic soil free from vegetation, roots, shingle, salts, organic matters, sod and any other harmful chemicals shall be used for filling. The contractor shall test the fill material to establish its suitability and submit the results to the engineer for approval. Fill material shall be got approved by the engineer. The following type of materials shall not be used for filling.

a) Materials from swamps, marshes and bogs
b) Expansive clays
c)Peat, logs, sod and perishable materials
d)Materials susceptible to combustion
e) Any material or industrial and domestic produce which will adversely affect other materials of work
f) Materials from prohibited areas

The earth available by cutting the high grounds within the project site and the materials (if) available from the road excavation or any other excavation under the same contract shall be used for filling depending upon its suitability as fill material. Filling with excavated rock (in the project site) shall be done only with the written permission of the engineer in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any

approved earth to fill the voids as for as possible and the mixture shall then be used for filling. In case the earth required for filling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc. shall be borne by him. He shall obtain and submit the necessary clearances/permissions from the concerned authorities to the engineer for the borrow areas/materials acquired.

## 4.00 QUALITY CONTROL

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

| Sl. No. | Activity | Check |
|---|---|---|
| 1 | Lines, levels & grades | a) By periodic surveys<br>b) By establishing markers, boards etc |
| 2 | Filling | (a) On quality of fill material<br>(b) On moisture content of fill material<br>(c) On degree of compaction achieved |

## 5.00 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of approaches, dewatering (if any), drainage and compaction etc. within 15 days of award of the contract to the engineer for approval.

### 5.01 Site Clearance

Before the commencement of earthwork, the entire area of cutting and filling shall be cleared of all trees, stumps, bushes, grasses, vegetation etc. with their roots, fences, logs, rubbish, water, slush etc. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below the existing ground level or 300mm below the formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed off to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timbers, fire

woods etc. shall be the property of owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

**5.02 Setting Out**

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for the ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. The contractor shall take spot levels of the area (with respect to the bench mark/ available source as provided by the engineer) to be excavated or to be filled at an interval of not more than 10m or as directed by the engineer before starting any earth work and shall be submitted to the engineer for prior approval.

**5.03 Excavation**

Levelling by excavation shall be carried out where the existing ground levels are higher than the specified formation level. Excavation shall include removal of all materials whatever nature as may be and whether wet or dry shall be carried out exactly in accordance with the line, levels, grades and curves shown on the approved drawings and/or as directed by the engineer. All excavations shall be done to the minimum dimensions as required. The contractor shall obtain prior approval of the engineer for the method he proposes to adopt for excavation in different types of strata including dimensions, side slopes and dewatering if any, stacking or disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. **Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.**
The rough excavation may be carried up to a maximum depth of 150mm above the final formation level. The balance shall be excavated with special care and the final surface shall be compacted by rolling with 6 passes of 8 to 10 tonne roller. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The contractor shall be paid for the extra excavation and filling at the appropriate items of work.

If the excavation is done to a depth greater than that shown on the drawing or as directed by the engineer due to the contractor's fault, the excess depth shall be

filled up to the required level with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer at the own risk and cost of the contractor.

Suitable slope in cutting as per the requirements and as directed by the engineer shall be adopted to withhold the face of earth. The contractor shall be held responsible for any damage to any part of the work caused by the collapse of the side of excavations.

**5.03.01 Excavation in Hard Rock**

Excavation in hard rock shall normally be done with blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces.

**5.03.02 Blasting**

**a) General**

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to

transport the explosives as and when required for the work in a safe manner to the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.

**b) Materials**

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

**c) Storage of Explosives**

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well-ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officerin-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.

Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine. Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

* not to touch the magazine shoes on ground outside the clean floor.

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

**d) Carriage of Explosives**

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

**e) Use of Explosives**

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities. Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot

holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc. and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be

present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc. shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc. shall be taken during blasting operations.

**5.03.04 Restrictions on Blasting**

a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
d) No large scale blasting operations will be resorted to when the excavation reaches the last one meter and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
e) The last blast shall not be more than 0.50 m in depth.
f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiseling or any other suitable method as approved by the engineer.

**5.04 Sorting of Excavated Materials**

The excavated material shall be carefully sorted for use in filling the areas in the project site by removing roots, grasses, organic matters and other objectionable materials and be sorted out into different types of materials for use and as directed by the engineer. The excavated material which is not considered fit for filling purpose shall be immediately removed and disposed at such a place and in such a manner as will be directed by the engineer. The material found unusable should be got approved by the engineer before actually disposing it off. The useful materials that cannot be used directly shall be heaped in separate area as stock piles. Stockpiles shall be of regular size as for as possible for ease of measurement. The materials heaped shall be utilized as and when required and as directed by the engineer. The cost of complete item of earthwork includes the cost of rehandling of the materials and temporarily heaped and reused.

**5.05 Disposal of Surplus/ Waste Materials**

Surplus and other waste materials shall be removed and disposed of from the construction site to the area demarcated by the engineer. No material shall be wasted unless approved by the engineer.

**5.06 Earth Work in Filling**

Levelling by raising with controlled fill of approved excavated/borrowed earth shall be carried out where the existing ground levels are lower than the specified formation level. After clearing site as per clause 5.01, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tons' roller. The approved earth/fill material shall then be spread in horizontal layers' not exceeding 300mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as

determined by standard Proctor's test as per IS: 2720 part-VII or 85% of relative density as per IS:2720 part-XIV as specified. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The fill material shall be tested for its optimum moisture content and maximum dry density as per IS: 2720, part-VII. Moisture content shall be checked at the source of supply in accordance with IS:2720 part- II and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck-mounted water tank etc. making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. **Flooding shall not be permitted for watering purpose under any circumstances.** If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise owing to wet weather the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the layers before compaction. For each of the above tests on the fill material, one sample for every 10,000cu.m shall be tested. Additional samples shall be tested whenever there is a change of source or type of material.

Before start of filling, the contractor shall submit the engineer his proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the engineer shall only be employed to compact the different type materials encountered during construction. If directed by the engineer, the contractor shall demonstrate the efficacy of the plant he intends to use by carrying out compaction trials. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The compacted layer shall be tested for its dry density as per IS:2720**,** part-XXVIII or XXIX as directed by the engineer. Samples shall be taken at the rate of one sample for every 10,000sq.m area of each compacted layer. In addition random checks shall be carried out in compacted layers by means of Proctor needle penetration test. Contractor shall submit all the test results to the engineer immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be replaced with approved material compacted to the density requirements and satisfaction of the engineer.

**Subsequent layers shall be placed only after the finished layer has been tested and accepted by the engineer.**

Where the filling is to be done across low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed

layer of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

**5.07 Dewatering and Drainage**

It shall be ensured that the area to be excavated/filled shall be free from water. The contractor shall remove the water (if any) by pumping or by any other means as approved by the engineer. At all times, the surface of cutting/filling during execution shall be maintained at such a cross fall as will shed water and prevent ponding. All existing drains/channels (if any) in the work area shall be suitably diverted by the contractor before taking up any excavation or filling. These diversions shall be such that it shall ensure effective disposal of water without any accumulation or flooding within the project site and in adjoining areas.

**5.08 Finishing Operations**

Finishing operation shall include the work of shaping and dressing the excavated/filled ground to the required grades, levels, lines, side slopes, cross-sections
and dimensions as shown on the approved drawings or as directed by the engineer.

**5.09 Turfing**

Turfing shall be provided at the slopes and other locations as shown on the drawings or as directed by the engineer. The turf shall be of approved quality of grass. The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds or other undesirable matter. The grass on the sod shall have a length of approximately 50mm and the sod shall be free of any

debris. Thickness of the sod shall be as uniform as possible with 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that all the dense root system of the grasses is retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than about 300mm x 250mm size but not so large so that it is convenient to handle and transport without damage.

The area to be sodded shall be previously constructed to the required slope and cross section. Prior to placing the sods, the slopes shall be **roughned** and wetted in order to have a satisfactory bond. The strips of sod shall be laid in close contact with each other and be tamped firmly in place so as to fill and close the joints between them. The turfing so laid shall be well watered and protected until final acceptance.

**5.10 Approaches**

The contractor shall provide proper approaches for workmen and inspection.

**5.11 Lighting**

Full scale lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the edges of excavations and fills.

**6.00 RATES AND MEASUREMENTS**

**6.01 Rates**

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding sections in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

**6.02 Measurements**

Method of measurements are specified in the proceeding sections. Where not so specified, the latest version of IS:1200, Part-1 shall be applicable.

a) The length, breadth and depth shall be measured correct to the nearest centimeter if measurements are taken by tape. Rounding of numerical shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in cutting shall be computed from these levels in cubic meter.

c) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in

stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rocks so arrived shall be taken as soil.

e) For earth work in filling, the actual measurements of fill shall be calculated by taking levels of the original ground before start of the work but after site clearance and after compaction of fills. The quantity of earth work in filling shall be computed from these levels in cubic meter.

f) For turfing, the measurement shall be made on the finished work in square meter.

| | TITLE: | |
|---|---|---|
| | **TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT** | SPECIFICATION NO. PE-TS-999-600-C023<br>VOLUME - II B<br>SECTION - D \| SUB-SECTION – D23<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 1 OF 5 |

# VOLUME – II B

## SECTION – D

## SUB SECTION – D23

## ANTI-TERMITE TREATMENT

## SPECIFICATION NO. PE-TS-999-600-C023

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C023 |
|---|---|---|
| Maharatna Company | **TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT** | VOLUME - II B<br>SECTION - D \| SUB-SECTION – D23<br>REV.NO. 00 DATE 03/10/2017<br>SHEET 2 OF 5 |

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# TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT

## 1.00.00 SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

## 2.00.00 EXECUTION

### 2.01.00 General

All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.

Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

### 2.02.00 Chemicals and Rate of Application

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

| Chemicals | | Concentration by Weight, Percentage |
|---|---|---|
| Chlorpyrifos Emulsifiable (IS 8944 - 1978) | : | 1.0 |
| Heptachlor Emulsifiable Concentrate (IS: 6439 - 1978) | : | 0.5 |
| Chlordane Emulsifiable Concentrate (IS: 2682 - 1984) | : | 1.0 |

### 2.02.01 Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300 mm) for column

pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / $M^2$ of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / $M^2$ of the vertical surface.

Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose.

**2.02.02 Treatment of Top Surface of Plinth Filling**

Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / $M^2$ of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.

**2.02.03 Treatment of Soil Surrounding Pipes, Wastes and Conduits**

Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building.

**2.02.04 Treatment of Expansion Joints**

These shall receive special attention and shall be treated in a manner approved by the Engineer.

**2.02.05 Treatment at Junction of the Wall and the Floor**

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface.
A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation.

**3.00.00 ACCEPTANCE CRITERIA**

The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period.

## 4.00.00 RATES

Rates shall be of complete work per unit area as stated in the Schedule.

## 5.00.00 METHOD OF MEASUREMENT

Complete work of anti-termite treatment shall be measured for plinth area treated.

This includes treatment, to foundations, walls, trenches, basements, plinth, burried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work.

## 6.00.00 I.S. CODE

Relevant code applicable for this Specification.

IS: 6313 (Part-II) 1981 : Code of Practice of Anti-Termite Measures in Buildings
Pre-constructional chemical treatment measures.

| | TITLE: QUALITY ASSURANCE TESTS AND INSPECTION | SPECIFICATION NO. PE-TS-999-600-C024 | |
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# VOLUME: II B

## SECTION – D

## SUB SECTION – D24

## QUALITY ASSURANCE TESTS AND INSPECTION

## SPECIFICATION NO. PE-TS-999-600-C024

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: QUALITY ASSURANCE TESTS AND INSPECTION | SPECIFICATION NO. PE-TS-999-600-C024 | |
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| BHEL Maharatna Company | | VOLUME - IIB | |
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# QUALITY ASSURANCE TESTS AND INSPECTION

## CIVIL & STRUCTURAL WORKS

| Item/Components | | Test Requirements | Remarks/Frequency of Test |
|---|---|---|---|
| 1. EARTH WORK | | | * For Test at S.No. 1, 2, 6 & 7 frequency of test shall be one in every 2000 $M^3$ for each type & source of fill material.<br># Frequency of test for Sr. No. 3, 4 & 5 shall be one in every 5000 $M^3$ for each type & source of fill material.<br>@ For foundation filling, one for every 10 foundations for each compacted layer. However for heavily loaded foundations, each layer shall be tested. For area filling, one for every 1000 $M^2$ area for each compacted Layer.<br>Note:<br>**The contractor shall include provision for setting up testing laboratory with all apparatus and equipments necessary for carrying out field tests.** |
| a) Earth Fill Material (Before Compaction) | 1 | Grain Size Analysis * | Y |
| | 2 | Liquid Limit & Plastic Limit * | Y |
| | 3 | Shrinkage Limit # | Y |
| | 4 | Free Swell Index # | Y |
| | 5 | Chemical Analysis # | Y |
| | 6 | STD Proctor Test * | Y |
| | 7 | Moisture Content * | Y |
| | 8 | Dry Density by core cutter/sand display cut @ | - |
| | 9 | Relative Density Index @ | - |
| | 10 | Dry Density by Proctor Needle Penetration @ | - |
| | 11 | All tests as per Indian/International STDS | Y |
| b) Earth Fill Material (After Compaction) | 1 | Grain Size Analysis * | - |
| | 2 | Liquid Limit & Plastic Limit * | - |
| | 3 | Shrinkage Limit # | - |
| | 4 | Free Swell Index # | - |
| | 5 | Chemical Analysis # | - |
| | 6 | STD Proctor Test * | - |
| | 7 | Moisture Content * | - |
| | 8 | Dry Density by core cutter/sand display cut @ | Y |
| | 9 | Relative Density Index @ | Y |
| | 10 | Dry Density by Proctor Needle Penetration @ | Y |
| | 11 | All tests as per Indian/International STDS | Y |

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C024 | |
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## CIVIL & STRUCTURAL WORKS

| Item/Components | | Test Requirement Checks | | | | | | Remarks/Frequency of Test |
|---|---|---|---|---|---|---|---|---|
| | | * Quantum of check for test at Sr. No 1 & 2 shall be one per 100 $m^3$ or part thereof or change of source is whichever earlier. | # To be done every day before start of work. | Note: For test at Sr. No. 3, 4, 5, 6, 7, 8, 9, 11& 12 once per source. For remaining as per IS Code. | | | | |
| 2. CONCRETING | | | | | | | | |
| a) Coarse Aggregate | 1 | Y * | Y * | - | - | - | Y | |
| | 2 | Y * | Y # | - | - | - | Y | |
| | 3 | Y | Y | - | - | - | Y | |
| | 4 | Y | - | - | - | - | Y | |
| | 5 | Y | Y | - | - | - | Y | |
| | 6 | Y | Y | - | - | - | Y | |
| | 7 | Y | - | - | - | - | Y | |
| | 8 | Y | Y | - | - | - | Y | |
| | 9 | - | Y | - | - | - | Y | |
| | 10 | - | Y # | - | - | - | Y | |
| | 11 | - | Y | - | - | - | Y | |
| | 12 | Y | Y | - | - | - | Y | |
| | 13 | - | - | Y | - | - | Y | |
| | 14 | - | - | Y | - | - | Y | |
| | 15 | - | - | - | Y | - | Y | |
| | 16 | - | - | - | Y | - | Y | |
| | 17 | - | - | - | - | Y | Y | |
| | 18 | - | - | - | - | Y | Y | |
| | 19 | - | - | - | - | Y | Y | |
| | 20 | - | - | - | - | Y | Y | |
| | 21 | Y | Y | Y | Y | Y | Y | |

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C024 | |
|---|---|---|---|
| BHEL Maharatna Company | QUALITY ASSURANCE TESTS AND INSPECTION | VOLUME - IIB | |
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## CIVIL & STRUCTURAL WORKS

| Test Requirement / Checks / Item/Components | 3. Form Work a) Staging | b) Shuttering | 4. Reinforcement | 5. Bricks | 6. Mortar | 7. Masonary | 8. Water Supply & sanitary items | 9. Water retaining structures (Tank/reservoir etc.) | 10. Roof water proofing | 11. RCC structures | 12. Doors Windows | 13. Pre-cast concrete members | 14. All bought out items Approval by BHEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load test on structures as per IS: 456 & core test | - | - | - | - | - | - | - | - | - | Y* | - | - | - |
| Water tightness test as per IS: 3370 & Is: 6494 | - | - | - | - | Y | - | - | Y | - | - | - | - | - |
| All Tests as per Indian/International Standard/ BHEL Tech. Spec. | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | - | Y |
| Core Test | - | - | - | - | - | - | - | - | - | Y | - | Y | - |
| Ultrasonic Test | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Verticality all | - | - | - | - | - | Y | - | - | - | - | - | Y | - |
| Work man ship | - | - | - | - | - | Y | - | - | - | - | - | - | - |
| Water Retentivity as per IS: 2250 | - | - | - | - | Y | - | - | - | - | - | - | Y | - |
| Consistency as per IS: 2250 | - | - | - | - | Y | - | - | - | - | - | - | - | - |
| Warpage | - | - | - | Y | - | - | - | - | - | - | - | - | - |
| Efflorences | - | - | - | Y | - | - | - | - | - | - | - | - | - |
| Water Absorption | - | - | - | Y | - | - | - | - | - | - | - | - | - |
| Compressive Strength | - | - | - | Y | Y | - | - | - | - | - | - | - | - |
| Plumb | - | Y | - | - | - | Y | - | - | - | - | - | - | - |
| Cutting tolerances | - | - | Y | - | - | - | - | - | - | - | - | - | - |
| Placement | - | - | Y | - | - | - | - | - | - | - | - | - | - |
| Dimensions | - | Y | Y | Y | - | - | - | - | - | - | Y | - | Y |
| Physical & Chemical Properties | - | - | Y | - | - | - | - | - | - | - | - | - | - |
| Cleanliness | - | Y | - | - | - | - | Y | - | - | - | - | - | - |
| Visual Exam. | Y | Y | Y | Y | - | Y | - | - | - | - | Y | - | Y |
| Joint Adequacy | Y | - | - | - | - | - | - | - | - | - | - | - | - |
| Durability, strength an soundness | Y | - | - | - | - | - | - | - | - | - | - | - | - |
| Remarks/Frequency of Test | | | | | | | | | | * These tests shall be carried out, incase of doubt regarding grade of concrete due to poor workmans-hip based on results of cube strength. | | | |

| | TITLE: | SPECIFICATION NO. PE-TS-999-600-C024 | |
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| BHEL Maharatna Company | QUALITY ASSURANCE TESTS AND INSPECTION | VOLUME - IIB | |
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## CIVIL & STRUCTURAL WORKS

| Item/Components / Test Requirements | 15. Structural Steel Like Columns, Girders, Beams & Truss Etc. | 16. C.W. Pipes/Ducts |
|---|---|---|
| Hydraulic test | | Y |
| All tests as per Indian/International Codes/Standards | Y | Y |
| Dimensional | Y | Y |
| Mechanical Test of Butt Weld Coupons | Y | - |
| Macrotech Exam. of Fillet Welds Coupons | Y | - |
| Fit up/Assy | Y | Y |
| Visual Exam. | Y | Y |
| Radiographic Test (RT) on Welds | Y | Y* |
| Liquid Penetration Test (LPT) on Welds | Y | Y |
| WPS/PQR/WQR | Y | Y |
| Ultrasonic Test (UT) on Material Above 40 mm Thickness | Y | - |
| Material T.Cs | Y | Y |

Remarks/Frequency of Test

1. Quantum of check for R.T. on butt welds under tension zone shall be 100% and for remaining butt welds unless specified shall be 10%. Acceptances norms for NDTs shall be as per AWS D1.1
2. RT on all butt welds for bunker supporting girders (Longitudinal/Transverse) shall be 100 %.
3. RT on all butt welds for deaerator supporting girders shall be 100 %.
4. All site fillet welds of bunker supporting structure shall be 100 % NDT.
5. All above quality control and super vision shall be carried out by an independent inspection body.

* 100% on 'T' joints and 10% on longitudinal and circumferential butt welds.

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## CIVIL & STRUCTURAL WORKS

| Item/Components | | 17. Roof Decking sheets (Supply and fixing) | 18. Wall Cladding work | | | | 19. Acid Resistant Lining | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | a) Outer sheet | b) Inner sheet | c) Insulation | d) Fixing of wall cladding | a) Acid resistant Bricks/Tiles | b) Acid resistant Mortar | |
| Test Requirements | | | | | | | | | |
| T.Cs for Physical & Chemical properties | 1 | Y | Y | - | - | - | - | - | |
| Dimensional, thickness, depth of valley etc. | 2 | Y | - | - | - | - | - | - | |
| Fixing of decking sheets | 3 | Y | - | - | - | - | - | - | |
| Sides end laps | 4 | Y | - | - | - | Y | - | - | |
| Appearance | 5 | Y | - | - | - | Y | - | - | |
| T.Cs for fasteners &'Z' spacers | 6 | Y | - | - | - | - | - | - | |
| Dimensional conformity | 7 | - | Y | Y | Y | - | Y | - | |
| Check for coating of silicon modified polyester paint thickness | 8 | - | Y | Y | - | - | - | - | |
| Galvanizing test as per IS code | 9 | Y | - | Y | - | - | - | - | |
| Check type of permanent colour coating | 10 | Y | Y | Y | - | - | - | - | |
| Tests as per BHEL tech spec. and IS: 8183 | 11 | - | - | - | Y | - | - | - | |
| Storage | 12 | - | - | - | - | Y | - | - | |
| Positioning and location of laps and plumb level | 13 | - | - | - | - | Y | - | - | |
| Compressive strength, Water absorption resistant to Acid, resistant to flexural strength, INEAD | 14 | - | - | - | - | - | Y | - | |
| Comp. Strength, bond strength working, time, chemical resistant | 15 | - | - | - | - | - | Y | Y | |
| Warpage | 16 | - | - | - | - | - | Y | Y | |

# VOLUME: II B

## SECTION – D

## SUB SECTION – D25

## RCC STACK

## SPECIFICATION NO. PE-TS-463-620-C002


Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | SPECIFICATION NO. PE-TS-463-620-C002 | |
|---|---|---|---|
| Maharatna Company | RCC STACK | VOLUME - IIB | |
| | | SECTION - D | SUB SECTION- D25 |
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# TECHNICAL SPECIFICATION FOR REINFORCED CONCRETE CHIMNEY

## 1.0.0 SCOPE

This specification covers reinforced cement concrete works, including brick flue and insulation work, painting and protective treatment work, and other works associated with construction of RCC single flue chimney.

## 2.0.0 GENERAL

### 2.1.0 Work to be provided for by the Contractor

Work to be provided by the Contractor, unless specified otherwise, shall include but shall not be limited to the following:

a) Furnish all labour, supervision, services, insurance, material, power, fuel forms, templates, supports, scaffolding, tools, plants, construction equipment, approaches, transportation etc. required for the entire work.

b) Design and prepare working drawings for formworks, scaffoldings, supports, staging hoisting arrangement for men and material etc. and submit them for approval.

c) Prepare and submit for approval, as per approved schedule, detailed drawings for RCC work in shell, platforms at various levels, roof and ground floor and bending schedules for reinforcement bars, showing the positions and details of spacers, chairs, supports, hangers, openings etc.

d) If in scope, prepare detailed fabrication and erection marking drawings for steel flues including flue expansion compensators, steel flue supports and restraint arrangements along with fittings and accessories and submit them for approval.

e) Prepare and submit for approval detailed shop drawings, with list of materials and material specifications for Load Bearing Insulation Blocks and Lateral Restraint Insulation Blocks.

f) Prepare and submit for approval detailed schemes for operations like material handling, placement of concrete erection of steel flues, fixing of insulations, installation, dismantling and maintenance of flue expansion compensator etc. and for items like approaches, services etc.

g) Design and submit for approval mix proportions for concrete to be adopted on job.

h) Furnish samples and submit for approval the results of tests for various properties of the following materials:
i) Ingredients of concrete, (ii) Concrete,
iii) Acid/Chemical Resistant Tiles, (iv) Castable refractories, (v) Insulation materials, (vi) Paints. (vii) S/S liner.

i) Provide all incidental items not specified or shown on drawings in particulars but reasonably implied or necessary for successful completion of the work in accordance with drawings and specifications.

j) Produce, if directed by the Engineer, a guarantee, in approved proforma, for satisfactory performance, for a specified period, of material manufactured by specialist firms.

2.2.0 **Work by Others**

No work under this specification will be provided for by agency other than the Contractor for this Contract unless specifically mentioned otherwise in the Contract.

2.3.0 **Codes and Standards**

All works under this Specification, unless specified otherwise, shall conform to the latest revisions/replacements of the following Indian Standard Codes, Criteria, Specifications, along with those mentioned therein. In case any particular aspect of work is not covered by Indian Standards, other standard specification, as may be specified by the Engineer, shall be followed. "IS Specification" shall mean Codes, Criteria etc. of ISI.

IS:6 Moderate heat duty fireclay refractories, Group-A.

IS:104 Ready mixed paint, brushing, zinc chrome, priming.

IS:158 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting for general purposes.

| | |
|---|---|
| IS:195 | Specification for fire clay mortar for laying fireclay refractory bricks. |
| IS:269 | Ordinary, and low heat Portland cement. |
| IS:383 | Coarse and fine aggregates from natural sources for concrete. |
| IS:432 | Mild steel and medium tensile steel bars. |
| IS:456 | Code of practice for plain and reinforced concrete. |
| IS:516 | Methods of test for strength of concrete. |
| IS:732 | Code of practice for electrical wiring installations (System Voltage not exceeding 650 Volts). |
| IS:800 | Code of practice for general construction in steel. |
| IS:813 | Scheme of symbols for welding. |
| IS:814 | Covered electrodes for metal arc welding of structural steel. |
| IS:816 | Code of practice for use of metal arc welding for general construction in mild steel. |
| IS:817 | Code of practice for training and testing of metal arc welders. |
| IS:818 | Code of practice for safety and health requirements in electric and gas welding and cutting operations. |
| IS:822 | Code of procedure for inspection of welds. |
| IS:875 | Draft Standard for Code of practice for structural safety of buildings loading standards. |
| IS:1080 | Code of practice for design and construction of simple spread foundations. |
| IS:1139 | Hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcements. |
| IS:1161 | Steel tubes for structural purposes. |
| IS:1199 | Methods of sampling and analysis of concrete. |
| IS:1200 | Methods of measurement of building works. |

| | |
|---|---|
| IS:1230 | Cast Iron Rainwater pipes and fittings. |
| IS:1239 (Part-I) | Mild steel tubes. |
| IS:1367 | Technical supply conditions for threaded fasteners. |
| IS:1526 | Sizes and shapes for firebricks (230 mm. series). |
| IS:1554 | Cables. |
| IS:1566 | Hard-drawn steel wire fabric for concrete reinforcement. |
| IS:1608 | Methods for tensile testing of steel products. |
| IS:1730 | Dimensions for steel plate, sheet and strip for structural and general engineering purposes. |
| IS:1731 | Dimensions for steel flats for structural and general engineering purposes. |
| IS:1786 | Cold-twisted steel bars for concrete reinforcement. |
| IS:1791 | Batch type concrete mixers. |
| IS:1893 | Criteria for Earthquake Resistant Design of Structures. |
| IS:1947 | Flood light. |
| IS:1977 | Structural steel (ordinary quality). |
| IS:2062 | Weldable structural steel. |
| IS:2074 | Ready mixed paint, red oxide - zinc chrome priming. |
| IS:2309 | Code of practice for the protection of buildings and allied structures against lightning. |
| IS:2386 (Part-I) | Methods of test for aggregates for concrete. Particle size and shape. |
| IS:2386 (Part-II) | Estimation of deleterious materials and organic impurities. |
| IS:2386 (Part-III) | Specific gravity, density, voids, absorption and bulking. |
| IS:2386 (Part-IV) | Mechanical properties. |
| IS:2386 | Soundness. |

(Part-V)

| | |
|---|---|
| IS:2386 (Part-VI) | Measuring mortar making properties of fine aggregate. |
| IS:2386 (Part-VII) | Alkali aggregate reactivity. |
| IS:2386 (Part-VIII) | Petrographic examination. |
| IS:2502 | Code of practice for bending and fixing of bars for concrete reinforcement. |
| IS:2505 | Concrete vibrators, immersion type. |
| IS:2506 | Screed board concrete vibrators. |
| IS:2633 | Methods of testing uniformity of coating on zinc coated articles. |
| IS:2722 | Portable swing weighbatchers for concrete (single and double bucket type). |
| IS:2750 | Steel scaffoldings. |
| IS:2751 | Code of practice for welding of mild steel bars used for reinforced concrete construction. |
| IS:2950 | Code of practice for design and construction of raft foundations. |
| IS:3025 | Methods of sampling and test (Physical and Chemical) for water used in industry. |
| IS:3043 | Code of Earthing. |
| IS:3144 | Methods of Test for Mineral Wool Thermal Insulation Material. |
| IS:3346 | Method for the determination of thermal conductivity of thermal insulation materials (two slab, guarded hot- plate method). |
| IS:3495 (Part-I to IV) | Method of test for clay building bricks. |
| IS:3550 | Methods of test for routine control for water used in industry. |
| IS:3558 | Code of practice for use of immersion vibrators for consolidating concrete. |

| | |
|---|---|
| IS:3677 | Unbonded rock and slag wool for thermal insulation. |
| IS:4014 (Part-I&II) | Code of practice for steel tubular scaffolding. |
| IS:4031 | Method of physical tests for hydraulic cement. |
| IS:4457 | Ceramic Unglazed Vitreous acidresistant tiles. |
| IS:4634 | Method for testing performance of batch-type concrete mixers. |
| IS:4687 | Gland packing asbestos. |
| IS:4832 | Chemical Resistant mortars. |
| IS:4860 | Acid-resistant bricks. |
| IS:4990 | Plywood for concrete shuttering work. |
| IS:4998 (Part-I) | Criteria for design of reinforced concrete chimneys. |
| IS:5410 | Cement paint, colour as required. |
| IS:5445 | Long fluted machine reamers with Morse taper shanks. |
| IS:5495 | Sizes and shapes for firebrick (300 mm. and higher series). |
| IS:6911 | Stainless Steel plate, sheet and strip. |
| IS:8112 | High strength ordinary portland cement. |
| IS:8183 | Bonded Mineral Wool. |
| IS:9595 | Recommendation for Metal Arc Welding of Carbon and Carbon Manganese steels. |
| CP326 - | British Standard - Protection of structures against lightning. |

NEPA NO. 78 Code of protection against lightning.

The Indian Electricity Rules.

The requirements of Department of Civil Aviation, Govt. of India.

2.4.0 **Conformity with Drawings and Specifications**

The Contractor shall carry out all the work in strict accordance with the drawings stamped "Released for Construction" and specification issued to him and as per Contractor's detailed drawings approved by the Consulting Engineer. Prior to concreting, the Contractor shall prepare a check list on a set format of all items of work involved, and inform the Engineer well in advance so that the Engineer shall have the opportunity of satisfying himself if the works mentioned in the format are done according to drawings and specification, and he can allow the Contractor in writing to start pouring of concrete. The entire operation of concreting shall be carried on as per specification, to the complete satisfaction of the Engineer. No deviation from the drawings will be allowed unless otherwise directed by the Engineer in writing.

For Load Bearing Thermal Insulation block assembly and lateral restraint insulation block assembly, Contractor shall design sizes of all components of the blocks and details of their connections, supply and fabricate the same in accordance with the approved shop drawings prepared by him.

For steelwork and metal work, the Contractor shall design all connections, inserts for scaffolding, supply and fabricate all steelwork and metal work and furnish all connection materials in accordance with approved shop drawings prepared by him and/or as instructed by the Engineer, keeping in view the maximum utilization of the available sizes and shapes for metal components.

2.5.0 **Materials to be used**

2.5.1 **General Requirement**

All materials, whether to be incorporated in the work or to be used temporarily for the construction, shall conform to the relevant IS specifications unless stated otherwise and shall be of the quality approved by the Engineer.

2.5.2 **Cement**

Ordinary Portland cement of grade 43, as per the requirements laid down in IS:8112, shall be used, until otherwise stated elsewhere in the specification.

### 2.5.3 **Coarse Aggregate**

Coarse aggregate shall be graded crushed or broken stone from approved sources, free from impurities and shall be screened free of dust and other deleterious matter. It shall conform to IS:383 or IS:515 and shall be washed clean, if necessary. The maximum size of coarse aggregate for stack superstructure shall be 25 mm down graded, unless otherwise stated (vide serial 5(b) of clause 3.03.06). Grading for a particular size shall conform to relevant IS Codes and shall be such as to produce a dense concrete of specified proportion and strength and shall be of consistency that will work readily into position without segregation.

### 2.5.4 **Fine Aggregate**

Fine aggregate shall be river or pit sand, free from any clay, earth, vegetable matters, salt or other impurities and shall be clean and fit for use, to the satisfaction of the Engineer. Sand acceptable for the work shall normally have a grading falling within the limits of one of the three grades, mentioned in the relevant IS Specifications.

### 2.5.5 **Water**

The water for both mixing and curing of concrete shall be clean, free from oil, acid, alkali, organic or other deleterious substances. Contractor shall test the water as and when required by the Engineer.

### 2.5.6 **Reinforcement**

Mild steel or Medium or High Tensile steel deformed bars specified for reinforcement shall conform to the latest relevant IS Specifications and shall be of tested quality under ISI

Certification Scheme. The reinforcement shall be free from any oil, foreign material or mill or rust scales.

2.5.7 **Steel Flue**

a) All mild steel material to be used in construction of steel flue shall comply with IS:2062, IS:1239, IS:1367, IS:1608, IS:800 and with other relevant IS Specifications. The ultimate tensile strength of this steel shall not be less than 410 N/Sq.mm.

b) Stainless steel liners shall be fabricated using materials conforming to the requirements of relevant IS Specifications and/or AISI 316L or BS:1449 Part-2. Grade of Stainless steel shall be equivalent to BS:1449 (Part-2) 316 S.12.

c) Materials to be used for fabrication of Flue expansion compensator shall be suitable for the flue gas tempeature and shall be acid resisting.

The Expansion compensator shall comprise several layers of materials given below in order from the gas side.

i) Two layer of insulation, each consisting of heavy weight texturized glass cloth impregnated with graphite suspension, having an approximate weight of 1.00 Kg/Sq.m

ii) A continuous filament glass cloth coated both sides with a flouro-elastomer having an approximate weight of 1.5 Kg/Sq.m.

iii) Two layers of PTFE (Poly Tetra Flouro-Ethylene) film of minimum thickness 0.15 mm each.

iv) A layer of glass felt of minimum thickness 10 mm and an approximate weight of 1.5 Kg/Sq.M.

2.5.8 **Paints**

Paints to be used for shop coat of fabricated steel shall conform to the IS:2074. Paint for treatment of outside face of Chimney with Cement water proof paint shall conform to IS:5410.

2.5.9 **Acid Resistant Tiles and Castable Refractories**

Acid resistant tiles to be provided over roof of stack should conform to IS:4457. Matching mortars to be used for tiles. Castable refractories shall be of hydraulic setting, rapid hardening type. It shall have refractory properties similar to Fire bricks conforming to IS:6, Group-A and working temperature shall be upto 1350 Deg.C.

2.5.10 **Insulations**

a) **On Exterior Surface of Flues**

The normal flue gas temperature inside the flue shall be 145 Deg.C with momentary rise upto 400 Deg.C (Maximum) occasionally. The insulation material shall be able to withstand this temperature without any deterioration in thermal properties or breakdown. The thermal conductivity of the insulating material shall not exceed 0.06 W/M Deg.C at a mean temperature of 150 Deg.C. The insulation shall also not be affected by any acid condensation from flue gas and shall be free from any impurities which may cause corrosion to the flue material.

For steel flues 65 mm thick semi rigid resin bonded fibrous mineral wool of density not less than 96 Kg/Cu.m as per IS:8183 or resin bonded fibrous crown glass wool (high temperature) of same thickness and density not less than 36 Kg/Cu.m capable of sustaining temperature to the tune of 540 Deg.C without any loss of material thermal property, may be used. The mineral wool for exposed top portion of flue shall be semi-rigid with minimum density of 200 Kg/Cu.M or the glass wool for exposed top portion of flue shall have minimum density of 75 Kg/Cu.M.

Slag wool insulation shall not be accepted.

The insulation free from shots should be supplied in the form of mat to be fixed with staggered joints on outer surface of the flue with suitably spaced stud by galvanised wire mesh. Insulation on the top portion of flue shall be covered by stainless steel cladding.

b) **At Load Bearing and Side Restraints of Flues**

Load bearing insulation assembly to have (i) a properly mechined mild steel plate with recess at its top for seating PTFE (Poly Tetra Fluoro Ethylene) sheets conforming to BS:5400 (ii) saddle plate (MS) in the middle having stainless steel plate fixed at its bottom surface and lead/elastomeric sheet at top, and (iii) top plate formed of two numbers insulation blocks each made of minimum 50mm thick rigid, non-combustible asbestos fibre reinforced lime-silica board (SINDANYO BLOCKS NATURAL GRADE CS-51) bonded to mild steel plates at top and bottom. For side restraints assembly of insulation blocks of SINDANYO Natural Grade CS-51 and stainless

steel plate shall be used. All stainless steel in these assemblies shall conform to AISI-316L and Mild steel to IS-2062. SINDANYO BLOCKS shall be suitable for operation at 320 Deg.C and shall primarily satisfy the following physical prolperties :

i) Minimum compressive stress prior to onset of compression yield of not less than 12 N/Sq.mm.

ii) Minimum shear strength of 30 N/Sq.mm when tested in accordance with BS:3497-1979.

iii) Thermal conductivity shall not exceed 0.67 W/m Deg.C at a mean temperature of 200 Deg.C and its coeff. of linear expansion not to exceed 1.2 x $10^{-5}$ per Deg.C.

iv) Adhesive used for bonding purposes shall be of material with equivalent high temperature properties as approved by the Engineer. It may be of "Fortafix Fiborclad Adhesive" as manufactured by Fortafix Ltd., England.

## 2.6.0 **Storage of Materials**

### 2.6.1 **General**

All materials shall be so stored as to prevent deterioration and intrusion of foreign matter and to ensure the preservation of their quality and characteristics for the work. Any material, which is deteriorated or is damaged or is otherwise considered defective by the Engineer, shall not be used for construction and shall be removed from site immediately, failing which the Engineer shall be at liberty to get the materials removed. The Contractor shall maintain an upto date accounts of receipt, issue and balance of all materials issued by the Owner.

### 2.6.2 **Cement**

Contractor shall store cement in water-tight and properly designed stores so that the Cement can be kept dry and the stock can be handled in rotation. The doors of stores shall

be at least 30 cm. above G.L. Deteriorated cement shall be removed immediately from the site. Not more than ten bags of cement shall be stacked one above the other.

### 2.6.3 Aggregate

Different materials shall be transported, handled and stored separately in such a manner as to prevent damage, deterioration or contamination. Stock piles of fine and coarse aggregates shall be allowed to drain, so that aggregates do not contain too much water.

### 2.6.4 Reinforcement

Reinforcement shall be stored preferably under cover and stacked off ground in size and grade-wise separate stacks for easy identification.

### 2.6.5 Steel, Metal and Fittings

All steel, metal and fittings to be used for fabrication and erection shall be stored sectionwise and lengthwise in separate stacks, off ground, so that they can be handled, inspected, measured and accounted for easily at any time. If required by the Engineer, the materials may have to be stored in a covered shed.

### 2.6.6 Paints

Paints shall be stored under cover, in air-tight containers. Paints supplied in sealed containers shall be used as soon as possible once the container is opened. Left over paints shall be kept in air-tight containers.

### 2.6.7 Steel Flue

Fabricated pieces of steel (flue) liner shall be stored systematically for ease of handling.

### 2.6.8 Insulation Material

All insulation materials like bearing insulation blocks, restraint insulation blocks, glass or mineral wool, asbestos ropes etc. shall be stored in packing boxes, under covered shed, avoiding their coming in contact with objectionable matter.

### 2.7.0 Quality Control

Contractor shall establish and maintain quality control for different items or work and materials as may be directed by the Engineer to assure compliance with contract requirement and submit to the Engineer records of the same.

The Contractor shall submit all records and test results in original to the Engineer for his approval, if so desired by him.

The quality control operation shall include but shall not be limited to the following items of work :

a) Cement : Test to satisfy relevant IS Specifications if supplied by the Contractor.

b) Aggregate : Physical, Chemical and Mineralogical qualities, grading, moisture contents and impurities.

c) Water : Impurities Test.

d) Reinforcement: Material tests or certificates to satisfy relevant IS Specification if supplied by the Contractor.

e) Structural : Material tests or certificate to satisfy Steelrelevant IS Specification if supplied by the Contractor.

f) Steel flue : Material tests or certificate to satisfy relevant IS Specification if supplied by the Contractor.

g) Stainless : Material tests or certificate to satisfy Steel relevant IS Specification if supplied by the Contractor.

h) Acid Resistant : Compressive and tensile strength, acid tiles& mortar resistance and water absorption test.

i) Mortar : Compressive and tensile strength, adhesion and acid resistance test.

j) Insulation : Thermal conductivity, density, heat and acid resistance tests. Bearing capacity will be tested for bearing/restraint insulation blocks.

## 3.0.0 EXECUTION

### 3.1.0 Concrete

#### 3.1.1 Trial Mix, Grades of Concrete

At least three weeks before commencing any concreting in the work the Contractor shall make trial mixes using samples of coarse aggregates, sand, water and cement, typical of those to be used in the work. A clean dry mixer shall be used for mixing and the first batch shall be discarded.

For guidance in designing the mix, standard tables for maximum allowable water-cement ratio, minimum cement content, maximum proportion of aggregates and limits of consistency may be used by the Contractor. The Contractor's design mix shall fall within limits of the following tables :

i) Strength requirements of concrete : Table-2 of IS:456-2000.

ii) Concrete Mix Proportion : Table-3 of IS:456-2000.

iii) Minimum cement content/Cu.m. of finished concrete shall be as per Table 5 of IS 456-2000.
However, it should be noted that minimum cement content for concrete of chimney shell of grade M30,M35,M40 shall be 400kg, 430 kg and 450 kg respectively.

iv) Limit of consistency : Refer Table in Item 3.1.4 of this specification.

v) Cement/Total Aggregate Ratio : As per the following table.

## MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO (FOR GUIDANCE)

### 3.1 CEMENT/TOTAL AGGREGATES RATIOS

| Workability | Water/ Cement Ratio | Ratio by Weight of Cement to Gravel Aggregate | | Ratio by Weight of Cement to Crushed Stone Aggregate | |
|---|---|---|---|---|---|
| | | 20 mm. Size | 38 mm. size | 20 mm. size | 38 mm. size |
| Very Low slump 0-25 mm. | 0.4 | 01:04.8 | 01:05.3 | 01:04.5 | 1:05 |
| | 0.5 | 01:07.2 | 01:07.7 | 01:06.5 | 01:07.4 |
| | 0.6 | 01:09.4 | 1:10 | 01:07.8 | 01:09.6 |
| | 0.7 | 1:10 | 1:12 | 01:08.7 | 01:10.6 |
| Low slump 25-50 mm | 0.4 | 01:03.9 | 01:04.5 | 01:03.5 | 1:04 |
| | 0.5 | 01:05.5 | 01:06.7 | 1:05 | 01:05.5 |
| | 0.6 | 01:06.8 | 01:07.4 | 01:06.3 | 1:07 |
| | 0.7 | 1:08 | 01:08.5 | 01:07.4 | 1:08 |
| Medium slump 50-100mm. | 0.4 | 01:03.5 | 01:03.8 | 01:03.1 | 01:03.6 |
| | 0.5 | 01:04.8 | 01:05.7 | 01:04.2 | 1:05 |
| | 0.6 | 1:06 | 01:07.3 | 01:05.2 | 01:06.2 |
| High slump 100 - 175 mm. | 0.4 | 01:03.2 | 01:03.5 | 01:02.9 | 01:03.3 |
| | 0.5 | 01:04.4 | 01:05.2 | 01:03.9 | 01:04.6 |
| | 0.6 | 01:05.4 | 01:06.7 | 01:04.7 | 01:05.7 |
| | 0.7 | 01:06.2 | 01:07.4 | 01:05.5 | 01:06.5 |

**NOTE-1 :** Notwithstanding anything mentioned above, the cement / Total aggregate ratio is not to be increased beyond 1:9 without specific permission of the Engineer.

It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water-cement ratios which may be required to be used in mass concrete work only.

**NOTE-2** : The above figures are for guidance only, the actual cement/ aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes. For each grade of concrete, a set of eighteen cubes shall be made. Of these not more than six may be made on any day and further, of the six cubes made in one day not more than two cubes may be made from any single batch. Nine of these cubes each representing a different batch of concrete shall be tested at the age of seven days and remaining at twenty eight days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with the relevant IS Specifications. The test shall be carried out in laboratory approved by the Engineer. If the average strength of the concrete cubes falls below the requirement, the method described above shall be repeated till acceptable results are obtained. The method may have to be repeated whenever there is a significant change in the quality of any of the ingredients for concrete, at the discretion of the Engineer.

### 3.1.2 Batching of Concrete

For controlled concrete, only weigh batching shall be allowed. All concrete ingredients, except water, shall be batched by weight, using an approved make of weigh batcher. Batching shall be accurate to 1/2 Kg. The batcher shall be tested for accuracy of calibration, first before commencement of work and at least once a fortnight or as directed by the Engineer thereafter. Water shall be batched by weight or by volume measures, as approved by the Engineer.

### 3.1.3 Mixing of Concrete

Materials for concrete shall be emptied in rotation into the mixer. When all the ingredients are in the drum, the drum will rotate for one minute for dry mixing. After that water shall be added in measured quantities in the manner specified. The mixer shall then rotate for at

least two minutes, or at least forty revolutions or until there is apparent uniform distribution of the materials and till the mass is uniform in colour. The entire content of the drum shall be discharged before the ingredients for the succeeding batch are fed into the drum. The mixer shall be thoroughly cleaned to the satisfaction of the Engineer, before a different quality of concrete is put through the mixer and also at the end of day's work.

3.1.4 **Workability of Concrete**

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments, and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests.120 mm to 150 mm, where concrete is pumped, otherwise, 100mm-120mm slump in chimney shell works shall be adopted subject to Engineer's approval unless stated otherwise (vide serial 1(d) of clause no. 3.3.6). The usual limits of consistency for various types of structure are given below:

## LIMITS OF CONSISTENCY

| Degree of Workability | Slump in mm. with Standard Concrete | | Use for which Concrete is suitable |
|---|---|---|---|
| | Min. | Max. | |
| Very Low | 0 | 15 | Large mass concrete work with heavy compaction equipment. |
| Medium | 35 | 65 | Deep and wide RCC structures with congestion of reinforcement and inserts. |
| 1.1.1 High RCC structures 1.1.2 1.1.3 | 65 | 100 | Very narrow and deep with congestion due to reinforcement and inserts. |

**NOTE**: The above table is for guidance only. Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately, to keep the ratio of water to cement same, as adopted in trial mix design, for each grade of concrete.

The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively, where facilities exist or if required by the Engineer, the compacting factor test, in accordance with IS:1199, shall be carried out.

### 3.1.5 Placing and Compaction of Concrete

Concreting shall proceed in a manner directed by the Engineer, concrete shall be placed in forms as soon as possible but in no case later than twenty minutes, after mixing.

The height of any single lift of concrete, for different structural members, shall be decided by the Engineer. The concrete shall be placed in the forms gently and not dropped from a height which may cause segregation of aggregates. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow

each other so closely that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken an initial set.

The concrete, after placing, shall be consolidated only by power driven vibrators. The vibrators shall be of a make and size, approved by the Engineer. In using the vibrator, the standard practice and the Engineer's directions, shall be followed.

Vibration shall begin as soon as one batch of concrete has been placed and shall continue till the entire section being poured has been thoroughly consolidated.

To secure even and dense surfaces, free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic, without damaging or endangering the stability of the formwork.

A sufficient number of spare vibrators including petrol vibrators shall be kept readily accessible to the place of deposition of the concrete to assure adequate vibration in case of breakdown of those in use.

### 3.1.6 **Curing of Concrete**

Curing of exposed surface of concrete shall commence immediately after the concrete has set. Exposed sides shall be covered with canvas etc. immediately after stripping of forms, and curing shall be continued for a period of not less than 14 days, reckoned from the date and hour of completion of concreting. All surfaces of the pour shall be kept wet with water at all times after concreting and till the curing period is over. The Contractor shall plan and employ proper equipment and sufficient labour considered adequate by the Engineer under able supervisor for curing.

### 3.1.7 Construction Joints

In concreting the chimney shell one full ring lift shall be completed in a day's pour. Before the formwork for the following pour starts the horizontal surface of the Chimney shell shall be chipped, cleaned and washed with water, and when the formwork is complete, the surface shall be cleaned and washed again and covered with 1:2 sand cement slurry before fresh concrete is placed. The horizontal construction joints shall be so arranged and made that they are regular and neat. No vertical joint shall be allowed. No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning them or cover with slurry prior to concreting. The number of construction joint shall be kept minimum and the spacing should not exceed three (3) meters. The Contractor shall submit to the Engineer, any proposal of providing construction joints to facilitate his work, for the study and approval of the Engineer well in advance.

### 3.1.8 Ordinary Concrete

Ordinary concrete like lean concrete shall be of nominal mix as per relevant clauses of IS:456.

### 3.2.0 Reinforcement

### 3.2.1 Bending of Reinforcement

All bars shall be carefully and accurately bent by the Contractor in accordance with approved Drawings and bar bending schedules. Special care shall be taken to ensure correct lengths of laps. The bars shall not be bent or straightened in any manner that will injure the bars or impair the bond between reinforcement & concrete. Bends and hooks are to be provided as laid down in the IS:2502.

### 3.2.2 Placing

All reinforcement shall be placed and maintained in the position shown in the drawings. Contractor shall provide approved type of cover blocks to suit the requirement of the Drawings. Where reinforcement is to be provided on two faces of the shell, the Contractor shall provide adequate number of separators, with the approval of the Engineer. Any additional support to the reinforcing cage, if required at the time of concreting, shall also be provided, to the satisfaction of the Engineer. Lapping of reinforcement as specified in the drawings or as directed by the Engineer, shall be provided. Laps shall be staggered and too many laps shall be avoided. Welded laps shall be provided only when directed or approved by the Engineer.

### 3.2.3 **Fixing of Reinforcement**

18 SWG annealed steel wire shall be used as binding wire. Bar crossing one another and contact laps shall be bound with this wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.

3.10 **Forms**

**Construction by Slip-form Method**

Slip-form construction shall be for construction of the wind shield. Type of Slip-form proposed should be indicated in the offer with sketches, drawings and construction statement as explained hereinafter. Number, type and capacities of jacks, the control system and achievable rate of progress in mm/hour should also be indicated. The chosen scheme shall be of a past proven design. A certified performance record of the scheme should be submitted with the offer to guarantee workability of the scheme both from execution time and safety point of view.

The Tenderer should furnish a brief but commprehensive statement indicating the planning & programme and method of work to be followed, for the approval of Owner at the time of submitting Tender. This statement shall include the following items:

i) Type and description of Slip-form equipment and its accessories.

ii) Design of scaffolding and staging.

iii) Description of materials including admixtures to be used for construction.

iv) Manpower planning, construction spaces required, standby arrangement.

vi) Rate of Slip-forming.

vii) Proposed workability requirement of concrete and type of cement & admixture to be used.

viii) Quality assurance programme.

ix) Method of Traansportation of material

x) Method of curing and rectification of defects.

xi) Planned interruption, if proposed, and activities during planned interruption. Treatment of construction joint.

xii) Contingency solution for unplanned interruptions.

xiii) Time of completion.

While selecting the Contractor, due consideration will be given to the merit of the above mentioned statement proposed by the Tenderer.

Not withstanding what have been specified in earlier clauses, following guide lines are being presented which should be kept in view by intending Tenderers, while quoting for Slip-form method of construction:

1. Care to be taken to prevent dragging of concrete along with upward movement of the shuttering. For this purpose following steps are advisable:

   a) Shutter plates have to be smooth and should be thoroughly clean. Before fixing them in position all the surfaces which will be coming in contact with concrete to have a coat of epoxy paint.

   b) In areas where concrete thickness is 750 mm or more, rate of pouring should be such that minimum slipping of shuttering is maintained to avoid initial set of concrete before slip form movement.

   c) Mix design should be so done that it will be self- lubricant at the contact face of shutter and concrete and thus reduce friction. Suitable cement of approved manufacturer (conforming to relevant I.S. Specification) may be used for the purpose. An optimum ratio of coarse/fine aggregate should be established to suit the purpose depending on availability of aggregates.

   d) Mix design also should be so done that it has a slump of around 100mm-120mm, at the point where concrete is placed under an ambient temperature of around 40 Deg.C. This will also keep vibration by needle vibrators to required minimum. Slump should not drop down to zero in less than 45 minutes. Suitable retarding agent and plasticizer of approved manufacture may be added in mix to achieve this purpose.

These admixtures to be properly identified by preliminary tests both for performance and for compatibility with particular type of cement proposed to be used.

Additional steps like spraying of water over the shutters and keeping down the temperature of coarse aggregates by continuous spraying of water over those may be resorted to if ambient temperature is more than 40 Deg.C.

2. Care must be taken to prevent twist, which predominantly occur in the initial stages because of low slipping rate, in the horizontal plane of Slip-form assembly. A thorough check on this aspect must be kept at every 15 minutes interval. One person should exclusively be assigned this work together with rectifying any defect.

3. Every endeavour has to be made so as not to occur any tilt in the shutter assembly. To achieve this following steps need be taken:

a) Performance of jacks has to be closely observed and any defective one needs immediate replacement. Difference in levels of opposite jacks at any instant of time should not exceed 5 mm.

b) Loading on Slip-form truss/yokes has to be fairly equal.

c) Sleeve through which jacking rod passes has to be of sufficient length so that later gets an uniform clearance and does not get any chance to tilt. Sleeve should have a minimum wall thickness of 3.25 mm and should be such that jacking rod gets a maximum clearance of 1 mm to 1.5 mm around.

4. For taper walled chimneys overlapping of shutters which are kept to effect the tapering, needs careful attention otherwise these may be filled with concrete slurry.

5. In designing the mix following aspects should be borne in mind:

a) Cement used should have an initial setting time of not less than 50 minutes and preferably should have a specific surface around 3600 Sq.Cm.per gram.

b) Coarse and fine aggregates should be well graded and rounded aggregates offer better performance in Slip-form technique. These help to keep down water/cement ratio and also offers better lubrication between concrete and shutter surface. 40 mm down size of coarse aggregates should preferably be used unless reinforcement detailing calls for lesser size aggregates.

c) From the point of view of creep, shrinkage as well as initial setting property of concrete, cement content should not preferably be more than 450 Kg. per Cu.M of concrete.

d) Minimum compressive strength (after 4 to 6 hours of mixing) of concrete immediately below the shutter as slipform proceeds should be between 0.1 to 0.2 Newton/ Sq.mm.

e) It is advisable to use cement from a single source during the entire operation of slipform technique since once the system starts, there might not be any time left for conducting trial mixes if the source of procurement of cement changes.

6. Large diameter vibrator needles should not be used for vibrating concrete. Sizes of these needles should preferably be restricted to 25 mm diameter and to 40 mm diameter - only in exceptional cases. At least two nos. standby vibrator units should always be maintained on top of working deck at all time during the entire period of slipform operation.

7. It is preferable to have membrane curing compounds sprayed on fresh surfaces emerging out of shutter panels for ensuring proper curing at great heights.

   In case such spraying is not envisaged then elaborate arrangement has to be made for adequate supply of water both on inside and outside vertical surfaces with spraying arrangement, necessary length of pipelines and pump of adequate head to serve the purpose. It is always advisable to have a stand-by pump for effective utilisation of the system.

8. Rate of slipping should be around 100 mm – 150mm per hour, subjected to a maximum limit of 3.0 m per 24hrs.

9. Exact number and capacity of jacks as well as spacing of yoke frames are to be determined taking into account various loadings including self weight of the system, dead and live loads on working and other platforms, horizontal load on formwork, wind load etc.

   It is desirable that jacking system, based on which the entire slip form system works, should consist of jacks 3 Tonne/ 6 Tonne capacity and a hydraulic pump with necessary pipe connections.

   Spacing of yoke legs should preferably be kept within 2 metres to prevent overloading on jacks and consequent failure resulting in twist of the formwork.

Jacking rods should be of 25 mm diameter for 3 Tonne Jacks and 32 mm diameter for 6 Tonne Jacks.

10. At least 30% spare jacks and jacking rods should be kept ready during the entire operation. It is obligatory to maintain spare hydraulic pump along with a set of loose pipes in perfect working condition on top of working deck.

11. In sections where thickness is 500 mm or more it is prudent to go in for two nos. of jacks for each slip form yoke.

12. For effective utility of this technique following areas need careful attentions at the very conceptual stage:

    a) Detailed quality assurance programme.

    b) Advance Planning and preparations.

    c) Arrangement for on site supervision and adequate access facilities.

13. Construction methods including description and types of different equipment proposed to be used, structural arrangement and analysis of the system, description and type of different materials, planned interruptions, description and frequency of various checks and tests for Slipform technique as well as for material, method of preparing, transporting and pouring of concrete, solution for probable defects during slipping, sequence of operations during planned interruptions etc. should be prepared beforehand by executing agency and to be approved by Engineer before starting the actual work.

14. Placing and binding of reinforcement is also a very critical item and needs special attention. From practical considerations not more than two or three layers of horizontal steel can be tied at a time and this causes a definite limitation in placement of reinforcement.

    Vertical reinforcements should be kept vertical by providing suitable holders within the slipform system.

15. It is desirable to have a break of at least one day for every two weeks of continuous operation. Such break should be utilised for various maintenance activities, removal of jack rods etc.

16. Numbers and locations of hoists for lifting concrete, reinforcement and other materials have to be planned well in advance. Capacity of hoists should be such as to match with hourly requirement of concrete and

reinforcement. If felt necessary one hoist may be exclusively earmarked for transporting concrete.

For movement of personnel supervising the work a seperate hoist must be arranged for.

17. The system being operative round the clock it is obligatory to have adequate lighting arrangement both on various platform levels as well as on ground below. Arrangement has to be made for facilitating continuous upward movement of the entire system alongwith slipform.

18. Winches for lifting men and material and mixers, if located within unnsafe area around chimney, should be protected by adequate shelter from possible damage.

19. Proper tele-communication system has to be established between the personnel working on top of Chimney and control room below.

20. A small laboratory should be maintained at site for testing different materials like cement, coarse and fine aggregates. A cube testing machine may also be installed at site for getting quick feed back results.

    Apart from using plumb bobs, level and theodolite instruments for survey purpose arrangement should also be kept for lasers.

21. In case of interruption in the course of slipping of formwork following measures should be taken:

    a) Provision of a key and additional reinforcement at the junction of new and old concrete.

    b) Slip form system should be brought up freely to have a minimum overlap of 100 mm or so over previously cast concrete.

    c) Washing of old concrete surface with compressed air and water jet and thereafter pouring a layer of neat cement grout.

    d) Clearing of shuttering panels of loose materials, concrete etc. by compressed air and applying a coat of epoxy paint, if felt necessary by Engineer.

    e) Neatly finishing the interface of old or new concrete as soon as it comes out of shutter panel.

22. It is preferable to suspend the construction work under high wind condition.

23. It is of utmost importance that for effective implementation of this system an Engineer fully conversant with Slip form technique with

enough experience in planning and control of formwork should be in overall command of the site and he should be ably supported by well trained mid level supervisory staff, skilled workers and operators, having experience of similar construction in past. It is to be noted that enough manpower (as agreed by owners engineer at site) of above mentioned quality, is always ensured at site for smooth and uninterrupted work of slip form.

24. Operation of slip form method of construction is a continuous one and it demands continuous/intermediate inspection of accuracies in line, level, dimensions and position and immediate rectification of any noticed deviation. All these ask for personnel of high quality having constant vigilance over the construction activity.

25. While all the activities in effective implementation of the work needs utmost care keeping safety of men and material in mind it is obligatory that all activities should be carried out under the guidance of a qualified and trained safety Engineer.

26. For smooth and unhindered supply of concrete, while the slip form is in operation, it is desired that batching plant for concrete of chimney shell be placed in close proximity of chimney shell. However, all the safety measures required for placing batching plant close to shell must be ensured.

Safety measures as listed below must be adhered to but should not be limited to only these:

a) Safety helmets and belts to be provided to all supervising staff and workers.

b) Safety nets to be provided below both inside and outside platforms as instructed by Engineer.

c) Hand railing and toe guard to be provided around all openings and platforms.

d) Regular maintenance of equipment, checking of hoists, scaffoldings etc.

e) Passenger hoist must have multiple ropes with adequate factor of safety.

f) Emergency lights, coloured lamps to be provided in accordance with relevant Indian Standards and as supplemented in the Specification and to be operative in case of sudden power failure Emergency standby generator must be kept ready during the entire period of slipform method of construction.

g) Emergency vehicles, first aid facilities must be kept ready during the entire period of work.

26. Permissible construction tolerances should be limited to the following:

| | | |
|---|---|---|
| Variation in wall thickness | : | (-) 5 mm, (+) 25 mm |
| Variation from Design Diameter | : | (±) 25 mm or (±) 2.5 mm per 3 m dia. whichever is larger, but in no case more than (±) 5 mm. |
| Out of Plumb in General | : | 1 in 1000 of height subject to a maximum of 200 mm. |

## 3.4.0 Steel Flues

### 3.4.1 General

Fabrication and erection of Steel Flues shall conform to "Technical Specification for Fabrication and Erection of Structural Steelworks" furnished in this Specification.

### 3.4.2 Fabrication

Plates out of which flues will be fabricated, should be bent to the required shape on an appropriate machine. No smithy process shall be adopted for the purpose. Plates are to be prevented from distorting by more than the tolerances specified during transportation, storage, handling, erection and jointing. All components should be correctly located and brought into correct alignment and level within specified erection tolerances, before adjacent pieces are jointed or secured.

### 3.4.3 Assembly

Each flue would be assembled from its Component "Cans" near to ground level within the wind-shield. Incomplete flue would be hung only from the flue support platform during assembly, and progessively hoisted to enable connection of further cans at its lower end. Upon completion of the initial sectional length, this length will be hoisted and supported in its final position at the flue support floogr as indicated in the drawing. It is envisaged that each flue will be assembled and hoisted in three sectional lengths; site joints between sectional lengthy being located just above a steel floor level.

Joints between individual cans should be flanged and bolted on outside and to have sealed welded joints on inside in accordance with clause 3.3.0 - "Welded Construction" under Technical Specifications" for Fabrication of

structural steel work. The Contractor shall submit a drawing showing proposals for erection and indicating locations of all site joints which should be kept to minimum.

### 3.4.4 Flue Expansion Compensator

For installation of Expansion Compensators, the manufacturer's instruction should form the basis of the Contractor's method. This method, in a statement, should be submitted to the Engineer for approval. Once approved it has to be followed throughout the installation sequence. Expansion Compensators should be prevented from distortion during transportation, handling, erection and jointing, by more stringout tolerances than specified by the manufacturer.

### 3.4.5 Tolerances

Permissible tolerances in the fabrication and erection of steel flues are given below :

a) Internal diameter shall not vary by more than : ± 12 mm

b) Centre of any section shall not be eccentric from vertical centre line by more than : 10 mm in any 15 metre height

c) Centre of any section at height 'h' is in mm. above GL shall : (h/2500 + 10 )mm, not be vertical centre where line by more than

d) Local deviation from a true circular form should not exceed the shell thickness (Measurement should be made from a segmental circular template having radius of flue shown in drawing and a chord length equal to 0.15 of that radius).

e) Peaking or stepping at welded horizontal seams shall not exceed 4 mm. (Measurement shall be made with a straight edged template long enough to contact the straight shell on either side of the peaked area).

### 3.4.6 Erection

Erection of Steel Flues and C.I. Chimney caps shall be done as per requirement of IS:800.

The Contractor shall submit to the Engineer a programme of erection for his approval. All plant, equipment, tools, tackle and any other accessories required for the erection shall be

provided by the Contractor. Storing and handling of fabricated materials for erection, setting out of members, providing temporary supports, bracing, fasteners, bolts, nuts etc. shall be the responsibility of the Contractor and shall be taken into account in quoting the rate.

### 3.5.0 Insulation and Protective Treatment

### 3.5.1 Acid and Heat Resistant Paint

Top 15 meters of the outside face of R.C.C. windshield horizontal surface at the top of windshield and inside face from the top of the windshield to the top of roof slab or as specified in the drawing shall receive a protective treatment of three coats of acid and heat resistant black paint. The quality and type of the paint shall have the prior approval of the Engineer. For this, a small area shall be painted and a sample of paint shall be shown to the Engineer.

The surface to be painted shall be prepared and primary coat, if required as per the paint manufacturer's specification and direction of the Engineer, shall be applied. The paint shall conform, unless otherwise stated, to the requirement of IS:158. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for his approval. The surface to be painted shall be completely dry before the paint is applied and the drying time between consecutive coats shall not be less than 5 hours. The overall combined thickness of paint shall be a minimum of 230 microns.

### 3.5.2 Cement Paint

The outside face of the Chimney shell, unless specified otherwise, shall be painted with Cement water proof paint. The quality shall be approved by the Engineer. Necessary samples shall be submitted to the Engineer for his approval. The surface of the shell shall be prepared as per paint manufacturer's specification. In addition, care shall be taken that the surface is free from stain, honey comb and any rough and uneven surface. The joints between two shuttering and two lifts of shuttering shall be so prepared that any uneveness, if by chance exists, shall be removed. If one coat of paint is not sufficient to give the required finish, the Contractor shall repaint the surface, until the Engineer is satisfied with the workmanship. The paint shall conform, unless otherwise stated, to IS:5410. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for approval.

### 3.5.3 Insulation and Packing

All insulation material should be of dimension and type, shown in the drawing. Load bearing insulations at supports and side restraints of Steel liners should be an assembly of M.S. Plates, Stainless Steel Plates, PTFE (Poly Tetra Fluoro Ethylene) sheets and or/asbestos fibre reinforced boards (SINDANYO BLOCKS). Insulation to be fixed on outer surface of steel flues should be made of glass or mineral wool.

a) **Load Bearing Insulation Block**

Load bearing assembly should consist of three units and be fabricated according to approved drawings. It would be fabricated from mild steel units with a stainless steel sheet bearing plate and load bearing insulation blocks as indicated in drawing.

The first unit is bolted to the supporting beam. It consists of a M.S. base plate with bolt holes on which a machined M.S. plate is welded. This plate is provided with recess for PTFE sheet (conforming to BS : 5400) to seat, being lubricated with silicon grease.

The second unit also consists of a M.S. plate having adequate size & thickness as shown in drawing. While one surface of the plate is provided with a stainless steel bearing plate the other surface has a thin layer of lead/ elastomeric sheet. The side having stainless steel surface is placed on PTFE surface of First unit.

The third unit consists of two layers of load bearing insulation blocks each having a minimum thickness of 50 mm and factory bonded to top & bottom M.S. plates. These are separated by 100 mm. long load bearing insulation dowels as shown in the drawing. These plates are in turn welded to two additional M.S. plates. Of the two surfaces thus created one shall be welded to bracket assembly while the other should rest on the lead sheet of second unit. Bearing assembly, thus formed, should be levelled by using suitable M.S. shims.

Support arrangement typically consists of flue support shoe (a part of flue), flue support bracket connected to the shoe by precision bolted connection. The bracket in turn is welded to the bearing assembly, which in turn is bolted to available supporting beams.

Support brackets and bearing assembly are welded to locally thickened area of flue. These support the flue on support platform at suitable locations indicated on the drawing.

The arrangement described above should cater for easy and smooth thermal movements of linear element. Suitable restraint brackets and M.S. stop plates need be provided as shown in drawings to prevent excessive movement and thus keeping different units of bearing assembly in proper position.

b) **Insulation Block at Lateral Restraints**

At flue restraint platforms, necessary restraint arrangement with load bearing insulation blocks and stainless steel bearing plates fixed to the insulation blocks should be provided as indicated in drawings.

Restraint and support brackets need be provided for the bottom supported portion of the flue which rests on the support platform provided at the base to cater for bearing and restraint requirements.

c) **Glass or Mineral Wool**

Insulation thickness of 65 mm as is specified in clause 2.05.10 shall be built up using two (2) layers composed of 40mm and 25 mm thick insulation blocks. Thicker layer shall be put as first layer around the flue on its exterior surface.

The insulation on the flue shall be fixed using chicken G.I. wire mesh, G.I. wire ties, insulation retaining studs, washers etc. All joints shall be staggered. The insulation shall be tightly secured to the exterior surface of the flue by impaling on the studs and fixing in place by means of 63mm round or square metal plated speed washers. 20 gauge galvanized wire netting shall be wrapped continuously over the entire exterior of insulation. The wire mesh shall be 25mm hexagonal pattern conforming to IS:1566. All joints in the mesh shall be tapped a minimum of 150 mm tied by 16 gauge soft annealed wire at 300 mm spacings. Lacing at joints shall not be used. The Contractor before application of insulation, shall take prior approval of actual fixing arrangement from the Engineer.

The insulation shall be able to sustain structural vibrations and shall not settle under such conditions during erection, construction & operation. The insulation shall be suitably tied to prevent dislocation under adverse conditions.

The cladding of stainless steel sheet over the insulation shall be well secured using pins, fasteners etc.

d) **Vermiculite Concrete**

Vermiculite concrete shall be made by mixing exfoliated vermiculite, portland cement and water. It shall be of Grade-B, having a density of 210 Kg./Cu.M. The vermiculite aggregate size shall be maximum 6 mm. The mix shall be 1 cement and 8 vermiculite by volume.

3.6.0 **Acid-Proof/Chemical Resistant Protection to Roof Slab**

Acid-Proof/Chemical Resistant tiles bedded on acid proof/chemical resistant mortar shall be provided for the protection of roof slab. The intervening space between the tiles shall also be filled up by chemical resistant/acid-proof epoxy mortar grouts. The mortar shall be used immediately after mixing.

Tiles shall be made of clay, feldsper or quartz and vitrified at a high temperature in ceramic kilns. These should be unglazed, free from

deleterious materials and should conform to IS:4457. Iron oxide in the raw materials used, shall not exceed 2 percent. They should show a fine grained, dense and homogenous fracture when broken. They shall be sound, true to shape, flat and free from flaws and other manufacturing defects. Dimensions of the tiles shall be 198.5 x 198.5 x 35 mm. Depth of the groove on the underside shall not be more than 3 mm. Compressive and tensile strengths of the tiles shall not be less than 70 N/Sq.mm and 3.5 N/Sq.mm respectively.

### 3.7.0 Flue Acid Drains and Manholes

Flue acid drainage system, where provided, will comprise of collection sumps, dilution manholes, conveying pipes including connection to main drainage system.

Stainless steel pipes, bends, collection sumps, fixing straps, bolts etc. conforming to the relevant Indian Standards (or in absence of which British Standard BS:3605) shall be used in work. Pipes should be cut and joined as per manufacturer's instructions so as to leave the surface clean and square to the axis of pipe.

Manhole should be constructed as per drawing. However, for general guidance it may be noted that pit of required dimensions should be excavated, lean concrete (1:2:4 mix) of required thickness to be laid, Acid-proof/Chemical resistant brick masonry in 1:4 acid resistant cement mortar of necessary thickness be built and both sides plastered by 12mm thick acid proof plaster (1:3 mix) having waterproof admixtures.

Manholes should be covered by reinforced concrete slab on which a heavy duty (HD) manhole cover with frame having diameter 560mm and total weight 255 Kg (140 Kg for manhole and 115 Kg for cover) is to be fixed. For additional safety another inner cover or other approved methods may be adopted. The manhole cover shall be distinctively coded to indicate the type of drainage involved.

Inside manholes necessary channels and benchings finished smooth by neat cement in cement concrete (1:2:4) and foot rungs made from 20mm round bars at 300mm centres and staggered should be provided. Rungs should project 100mm from wall face and be embedded 200mm inside cement concrete block made in that location of brick work. These foot rests shall be painted with coal tar in the projected portions and cement slurry in the embedded part. Joint of any pipe with brick work shall be rendered perfectly leak proof.

Pipes and fittings in the connection pipe to the main drainage system shall be vitrified clayware conforming to relevant IS and laid to the line and level indicated in the drawings.

### 3.8.0 Roof Drainage

### 3.8.1 General

Rainwater outlets and down comers to run along inner face of stack wall, shall be made of standard cast iron rainwater pipes conforming to IS:1230. The brackets used to hold the pipes alongside the walls shall be wrought iron clevis type, split ring type or of perforated strap iron as approved by the Engineer. Each vertical pipe shall hang freely on its bracket fixed just below the socket. Suitable spacer blocks are to be kept in between the pipe and wall surface for fixing the pipe. All bends and junctions shall be provided with water tight clean-outs.

3.8.2 Pipe Joints

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and water tight when under ground. Method of pipe cutting and jointing shall be as per instruction of the pipe and fittings manufacturer or as approved by the Engineer. However following guidelines may be followed in absence of any instruction available from the manufacturer.

Socket and Spigot pipes shall be joined by cast lead joints. Spigot of the following pipe should be centred in the socket of the preceding pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. After the gasket or hemp yarn has been caulked tightly, a jointing ring shall be placed round the barrel and tightened against the face of the socket to prevent air lock. Molten lead shall then be placed round the barrel and tightened against the face of the socket. Thereafter molten lead should be poured in to fill the remainder of the socket and caulked with suitable tools tight round the joint to make up for shrinkage of the molten metal on cooling and should be finished 3mm behind the socket face. If any joint is suspected to be damaged it has to be opened out & redone.
Joints in cast iron pipes with special jointing arrangements like "Tyton" joints etc. shall follow the instructions of the manufacturer.

## 4.0.0 TESTING AND ACCEPTANCE CRITERIA

### 4.1.0 General

The Contractor shall carry out all sampling and testing in accordance with the relevant IS Specifications and as supplemented herein, for the following items or any other item as may be required by the Engineer unless otherwise specified in this specification. The Contractor shall get the specimens tested in laboratory, approved by the Engineer and shall submit to him, the original test results in triplicate, within seven days after the completion of the test. Engineer may present himself while such tests are being carried out.

4.2.0 **Cement**

Representative samples shall be taken as per the relevant IS Specification from each consignment of Cement received from the Purchaser/Manufacturer/Supplier for carrying out the tests for fineness (by hand sieving), setting time, compressive strength and soundness tests, and the Contractor shall carry out the above tests as per relevant Indian Standard. If the cement is supplied by the Contractor the test shall be carried out by him. The Contractor shall carry out any or all the tests on aggregates as may be required by the Engineer, in accordance with IS:2386 Parts-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant IS specifications.

4.3.0 **Water**

Sampling and testing of water being used for concrete works shall be carried out as per IS:3550, by the Contractor, at regular intervals and whenever directed by the Engineer. The final acceptance criterion in case of doubt shall be as per IS:3025.

4.4.0 **Concrete**

The Contractor shall take cubes for works test as per requirement laid down in IS:516 regularly from the day's pour. The number of test cubes to be taken shall be as per IS:456. The Engineer may also use his discretion in deciding the rate of cubes to be taken. The acceptance criteria is to meet the requirement of IS:456. If the cube test results indicate that some portions of the work is below the required strength, the Engineer may order demolition of that portion of work which is below strength and ask the Contractor to rebuild, provided a satisfactory method of load testing is not possible. Such testing or demolishing and rebuilding shall be carried out by the Contractor.

4.5.0 **Steel Flue**

All site and shop welded joints shall be inspected and tested in accordance with clause 4.00.00 of Technical specification for Fab. and Erection of structural steel work.

4.6.0 **Insulations**

The insulating materials shall be tested for its stipulated characteristics and properties in accordance with the latest editions of IS:3144 and IS:3346 and/or as directed by the Engineer.

## 5.0.0 INFORMATION TO BE SUBMITTED

### 5.1.0 With Tender

The following technical information are required with the tender:

a) Source and arrangement of processing of aggregates proposed to be adopted.

b) Type of plant and equipment proposed to be used.

c) Names of firms with which association is sought for to execute the special items of work e.g. flue expansion compensator, load bearing insulation blocks etc. in the contract.

d) Types of formwork proposed to be used. All details as per clause no. 3.03.06 to be submitted, if slip form method is proposed to be used.

e) Shop proposed for fabrication of steel (flue) liners. Detailed write-up on procedure of erection of complete liner system including details of equipment proposed for the same.

f) For insulating material tests to be offered for inspection & tests for which test certificates will be submitted. A drawing showing the details of fixing insulation on the flues at bearings, lateral restraints and exterior surface.

g) Proposal for lifting of men and material in constructing the chimney.

### 5.2.0 After Award

The following information and data including samples where necessary, shall be submitted by the Contractor, progressively during the execution of the Contract.

### 5.2.1 Programme of Execution and requirement of Materials

Within 30 days of the award of the Contract, the Contractor will submit a Master Programme for completion of the work giving monthwise requirement of materials, particularly mentioning in details the materials which are to be supplied by the Owner and for the procurement of which the help of the Owner is required as per the terms & conditions of the Contract. In case the Contractor proposes to take on hire any

machinery or tools and plants from the Owner, the detailed phased out programme of such hire is also to be submitted.

The master programme may have to be reviewed and updated by the Contractor quarterly or at more frequent intervals as may be directed by the Engineer depending on the exegencies of the work.

Detailed day to day programme of every month is to be submitted by the Contractor before the commencement of the month.

5.2.2 **Samples**

Samples of all materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities, for approval. All samples shall be submitted well in advance of starting work at site. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying material of specified quality.

5.2.3 **Design Mix**

Design mix as per details of this specification giving proportions of ingredients, sources of aggregates and cement along with accompanying test results of trial mixes as per relevant IS Specifications shall be submitted to the Engineer, for his approval, before it can be used on the work.
Further, the mix design for concrete of shell to be validated from a third party agency of national repute, as agreed upon by the owner.

5.2.4 **Detail Drawings**

Following items shall be provided by the Contractor which are to be approved by the Owner and Consultant.

a) Detail drawings and designs of form work including scaffolding to be used. If slipform method of construction is adopted, then detail drawings showing all the arrangements for slipform technique including methods for reducing internal diameter and providing required slopes on outer diameter.

b) Detail drawings and bar bending schedules for concrete components.

c) Shop drawings for structural steel and metal work, including inserts etc. The Contractor shall submit his proposal for testing site and shop joints provided in steel members.

d) Detail drawings for templates and temporary supports for embedments.

e) Category wise requirements of MS, tor and structural steel including GI flats of various sizes for procurement.

f) Detailed drawings of steel flues indicating details of joints, supports and restraints including insulation blocks, and details of expansion compensator.

g) Detailed drawing of hoisting arrangement for men and material satisfying statutory regulations laid down for safety purpose.

5.2.5 **Reports**

Following Test Reports shall be furnished by the Contractor:

a) Mill Test Report for cement and reinforcing steel if the materials are supplied by the Contractor.

b) Inspection Report of bought out items.

c) Inspection Report of formwork and reinforcement, insulations etc.

d) Reports of tests of various material and concrete.

e) Radiographic tests on welded joints in steel flues.

d) Any other data or report or test result required by the relevant IS Specifications and if required by the Engineer for satisfactory quality control of the workmanship.

| | TITLE: | SPECIFICATION NO. PE-TS-999-620-C002 | |
|---|---|---|---|
| Maharatna Company | BOROSILICATE GLASS BLOCK LINING SYSTEM | VOLUME - IIB | |
| | | SECTION - D | SUB SECTION- D26 |
| | | REV. 0 | DATE 19/02/2020 |
| | | SHEET 1 of 8 | |

# VOLUME: II B

## SECTION – D

## SUB SECTION – D26

## SPECIFICATION NO. PE-TS-999-620-C002

## BOROSILICATE GLASS BLOCK LINING SYSTEM

Maharatna Company

**Bharat Heavy Electricals Limited**
**Project Engineering Management**
**PPEI Building, Power Sector,**
**Plot No. 25, Sector 16A,**
**Noida (U.P.)-201301**

| | TITLE: | |
|---|---|---|
| Maharatna Company | BOROSILICATE GLASS BLOCK LINING SYSTEM | SPECIFICATION NO. PE-TS-999-620-C002 |
| | | VOLUME - IIB |
| | | SECTION - D / SUB SECTION- D26 |
| | | REV. 0 DATE 19/02/2020 |
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| | TITLE: | SPECIFICATION NO. PE-TS-999-620-C002 | |
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| BHEL Maharatna Company | BOROSILICATE GLASS BLOCK LINING SYSTEM | VOLUME - IIB | |
| | | SECTION - D | SUB SECTION- D26 |
| | | REV. 0 | DATE 19/02/2020 |
| | | SHEET 3 of 8 | |

## 1 PROJECT DESCRIPTION

1.1. Description

This specification covers borosilicate glass block lining system in thermal power plant chimney.

1.2. Flue gas parameters

The chimney shall be working with the flue gas parameters as per Annexure-I.

1.3. General configuration

The Chimney general arrangement configuration shall be as provided elsewhere in the specification. However, during detailed engineering, modification may be done.

## 2 SCOPE OF WORK

2.1 Work to be provided by the contractor, unless specified otherwise, shall include but shall not limited to following:

2.1.1 Design, preparation of working drawings, material supply, erection, application, Handling, transportation, storage, preservation, pack and furnish with adequate moisture proof packing and test of borosilicate glass block lining system on flue liner substrate including:

a) Suitable primer, two component suitable adhesive membrane and closed cell borosilicate glass blocks.

b) Required Surface finish of flue liner substrate as recommended by borosilicate glass block lining system manufacturer/supplier.

c) Installing borosilicate glass block lining system on flue liner substrate using two component suitable adhesive membrane under controlled temperature and humidity conditions, including skilled labor, material, tools & tackles, equipment required to create controlled temperature & humidity conditions during installation, hot blow cleaning (after priming, if required) of flue liner substrate before application, mixing of two component suitable adhesive membrane by automated mixing machines etc. all complete.

d) Complete onsite QA and supervision, by borosilicate glass block lining manufacturer/supplier, during surface finish of flue liner substrate, application of primer, application of two components suitable adhesive membrane, installation of borosilicate glass blocks on flue liner substrate

2.1.2 All necessary parts, and works necessary for transport, storage and application purposes.

2.1.3 Submission of the drawings and getting the same approved from BHEL and the project owner.

2.1.4 The contractor shall furnish all design, labor, materials, tools and equipment necessary for the installation of borosilicate lining system, as indicated and specified herein.

2.1.5 The Work shall include everything requisite and necessary to finish the job properly, to the satisfaction of engineer in charge, notwithstanding that every item of labor or materials or accessories required to make the installation complete may not be specifically mentioned.

2.1.6 The Equipment / material for the Unit shall be supplied complete with provisions for appurtenances and accessories, to form a complete system which will achieve and assure safe and reliable operation with best overall performance.

2.1.7 Contractor shall provide, in the required format and form and in a timely manner, all drawings and documentation required by this Specification and/or required by applicable Standards and codes. A consistent nomenclature shall be used project-wide in naming all component parts within the Scope of Work. This shall apply to all drawings, Bill of Materials, special instructions, etc. The cost of correcting inconsistent nomenclature shall be borne by the contractor.

2.1.8 Changes in design and drawings already approved by the owner are normally unaccepted. However, should such changes become necessary on an exceptional basis, the contractor shall obtain the owners approval prior to introducing any such change.

2.2 Contractor Services

Field personnel provided by the contractor shall be capable and qualified to perform the required duties to the satisfaction of BHEL and the owner.

## 3 SPECIAL EQUIPMENT, TOOLS AND INSTRUMENTS

Contractor shall provide all special equipment, tools and instruments, skilled manpower required for handling and storage, and for test and maintenance of borosilicate glass block lining system provided under this Contract.

## 4 STANDARDS AND CODES

4.1 The borosilicate glass block lining system to be provided under this Specification, including all appurtenances and accessories, shall be designed, inspected, tested, stamped and preserved to the extent indicated in said referenced standards and codes. Where this Specification does not include such reference, the system, or any of its components, shall be designed, inspected, tested and preserved, as applicable, to comply with currently recognized International and/or manufacturer's/suppliers specification, whichever is stringent and more restrictive.

4.2 In all cases contractor shall adhere to and comply with the requirements of Indian standards, which are found to be more restrictive than those specified herein.

## 5 QUALITY ASSURANCE AND QUALITY CONTROL

5.1 The contractor shall submit upon request a copy of Its Quality Assurance Manual including Quality Procedures.

5.2 The contractor shall conduct an inspection and testing program which shall record and verify the essential properties of the constituent materials and the finished liner.

5.3 The contractor shall conduct test to verify the mechanical properties of borosilicate glass blocks and two components suitable adhesive membrane and the tests shall be documented during the course of design and shall be made available to owner.

5.4 Unless otherwise specified the contractor, standard tests shall be performed on all batches of materials furnished. The owner may or may not elect to witness tests, but the contractor shall notify the owner in advance of all scheduled tests.

## 6 SAFETY, NOISE AND ENVIRONMENT REQUIREMENTS

### 6.1 SAFETY

The material and equipment supplied under this specification shall meet the U.S. "OCCUPATION, SAFETY, AND HAZARD ADMINISTRATION" (OSHA) requirements or equivalent.

#### 6.1.1 Jobsite Safety and Scrap Disposal

- Safety programs and procedures shall be within the scope of this specification. It should be noted that materials that are potentially flammable, must be handled in keeping with good industry practice and in compliance with the manufacturer/supplier recommendations.
- Proper disposal of scrap and waste materials shall be followed by the contractor as instructed by owner.

#### 6.1.2 Safety and protection of material, work and property:

The contractor shall provide for the safety and protection of the work, materials and equipment to be incorporated therein, whether in storage on or off the site. Provide protection at all times against rain, wind, storms, condensation, or heat so as to maintain all work, equipment and materials free from damage. At the end of each day, all new work likely to be damaged shall be appropriately protected.

### 6.2 Environmental Data

6.2.1 The contractor, upon request shall provide a plan for the treatment of the discharge/waste to meet current regulations of the Indian government/ regulatory authorities.

6.2.2 The contractor, upon request shall provide additional information on noise and/or other environmental data. All information shall be prepared in a manner acceptable to Indian government/ regulatory authorities.

## 7 TECHNICAL REQUIREMENTS

7.1 Design parameters

7.1.1 Liner considerations

The borosilicate glass blocks shall be of suitable thickness as per the scope. Proper provisioning should be made for borosilicate glass block lining system for protection around gas sampling ports, expansion joints, man holes, mini-shell and other appurtenances.

7.2 Performance Requirements

7.2.1 Borosilicate glass block lining system shall be designed in such a way that it will not require unscheduled outages for repair except for planned and scheduled routine maintenance and inspections.

7.2.2 Borosilicate glass block lining system and all of the required components shall be designed for a safe, useful life of thirty (30) years (minimum).

7.2.3 Ten (10) year full replacement guarantee, including supply, erection, enabling works, labor, material (borosilicate glass blocks, two components suitable adhesive membrane, suitable primer), surface preparation, arrangement for application etc. all complete, and fulltime onsite QA supervision during erection & commissioning.

During the guarantee period if the lining system fails to protect the subject surface from deterioration, the contractor shall replace the partially affected portion or complete borosilicate glass block lining system without any additional cost.

7.2.4 The borosilicate glass block lining system shall be offered by a manufacture/supplier with demonstrated capabilities in the area of onsite technical support and QA/QC supervision, who employs QA/QC supervisors with a demonstrated experience in technical support and QA/QC supervision of the subject lining system.

7.2.5 The borosilicate glass block supplied lining system shall be capable of withstanding fire risk for a minimum period of 2 hours as per ASTM E-119 or equivalent codes/standards. Proper certification from an independent institute of sufficient knowledge and experience shall be submitted by supplier subject to acceptance by the project owner, showing the capability of the borosilicate glass block lining to protect the steel chimney flues from structural damage by fire of said rating.

7.2.6 Contractor shall produce certificates from an independent institute of sufficient knowledge and experience, subject to acceptance by the

project owner, showing that the workers can do the work on supplied lining system safely, without any adverse health effects and without requiring excessive protective measures.

7.3 Design Requirements

7.3.1 General

- Design of the borosilicate lining system must be performed by a professional engineer in the design of such system for thermal power plant chimneys.
- Requirements of this specification are to be regarded as minimum requirements. If the manufacturer/supplier design and/or experience dictate these minimum requirements should be exceeded, the design, supply and application shall be performed accordingly, without any extra cost implication.

7.4 Materials Requirements

The flue liner substrate shall be internally protected with borosilicate glass block lining system consisting closed cell borosilicate glass blocks, two components suitable adhesive membrane and suitable epoxy primer meeting all of the following requirements:

7.4.1 The borosilicate glass block lining system shall use closed cell borosilicate glass blocks with the following properties:

a. Density of 0.19 x 10^3 kg/m3 (+/- 20%).
b. Coefficient of linear thermal expansion not greater than $5.7x10^{-6}$/°C.
c. Min. compressive strength of 1.00Mpa as per ASTM C165/C240.
d. Minimum flexural strength of 0.62 Mpa as per ASTM C203/C240.
e. The blocks shall be resistant to thermal cyclic loading under FGD bypass/ hot gas service conditions, and sudden temperature changes, including high temperature spikes.

7.4.2 The borosilicate glass block system shall use a flexible, chemically resistant adhesive, with all required surface preparation, primer, labor, equipment etc., all complete. The adhesive membrane shall be a 2-component having excellent elastomeric properties and be acid & heat resistant. The adhesive membrane shall be applied in between and behind the blocks in a minimum 3 mm thick layer ensuring a proper bond and adhesion. The adhesive membrane shall have the following properties.

a. Minimum tensile strength at 23 °C of 1.0 N/mm2 as per ASTM D412
b. Resistant to corrosive flue gas environments.
c. Remain elastomeric and flexible under hot gas conditions and sudden temperature changes.
d. The adhesive shall be suitable for trowel application.

7.4.3 The steel substrate shall be grit blasted to a cleanliness of SA 2 $^{1}/_{2}$ and approved by the manufacturer/supplier of the borosilicate glass block lining system. The substrate shall thereafter be primed using a high performance epoxy primer within a short time window approved by the manufacturer/supplier. The lining system manufacturer/supplier shall demonstrate a proven Quality Control system that monitors and documents the key physical properties, as described above.

## 8 HANDLING, STORAGE AND PROTECTION

8.1 Facilities

8.1.1 Contractor shall construct adequate facilities for the storage of material. Upon completion of fabrication, the contractor shall remove the fabrication facility from the site and return the area to the pre-construction condition.

8.1.2 The installation of borosilicate lining system must be done in a suitable environment (temperature, humidity etc. control as per manufacturer recommendation to stand by the required guarantee). Maintenance of the required suitable condition and any tools/tackles, machinery required to maintain the controlled environment during installation of borosilicate glass block shall be in the scope of contractor.

8.2 Storage

8.2.1 Materials shall be stored in a dry area and within the temperature and humidity limits recommended by the manufacturer/supplier. Do not allow shelf-life limits, as determined by the manufacturer/supplier, to be exceeded.

8.2.2 Materials surfaces shall be protected from dust, fog, rain and other contaminants.

8.2.3 Affected materials shall be removed if any of the above requirements are not met.

## 9 JOB SITE INSPECTION AND PREPARATION

9.1 In coordination with the chimney contractor the borosilicate glass block lining system installation agency should submit a plan detailing the application sequence and methods to be employed, including moving, handling, storage, erection, fit up and the methods to be used for environmental protection.

ANNEXURE-I flue gas parameters

# DATA FOR CHIMNEY DESIGN

| GENERAL DATA | | | | |
|---|---|---|---|---|
| **Project Name** | **NABINAGAR 4x250 MW** | | | |
| **Boiler Application** | Utility | **No. of Chimneys** | By PEM (Existing Chimney) | |
| **Boiler Capacity** | 250 MW | **Type of Chimney** | By PEM (Existing Chimney) | |
| **No. of Boilers / No. of Absorbers** | Four (04) / Four (04) | **Chimney Arrangement** | By PEM (Existing Chimney) | |
| **Fuels Fired** | Coal | **Height of Chimney** | By PEM (Existing Chimney) | |
| | | | | |

| OPERATING CONDITIONS (Per Boiler) | | | | |
|---|---|---|---|---|
| **Boiler Load** | | | **Guarantee point** | **Design point** |
| | | | **250 MW** | **VWO** |
| **Type of Coal** | | | ------ | ------ |
| **At absorber outlet** | | | | |
| **Flue Gas Flow** | : | **TPH** | 1342.89 | 1461.55 |
| **Flue Gas Volume** | : | **$m^3$ / s (wet)** | 361.54 | 403.96 |
| **Flue Gas Temperature** | : | **°C** | 57.8 | 61.6 |
| **Flue Gas Density** | : | **kg /$m^3$** | 1.03177 | 1.00502 |

| FGD OUTLET-FLUE GAS COMPOSITION % BY weight– (WET BASIS) | | | | |
|---|---|---|---|---|
| **$CO_2$** | : | % | 14.837 | 14.44 |
| **$N_2$** | : | % | 67.083 | 65.27 |
| **$O_2$** | : | % | 6.763 | 6.57 |
| **$SO_2$** | : | % | 0.0048 | 0.0046 |
| **$H_2O$** | : | % | 11.309 | 13.699 |
| | | | | |

| *DUST SIZE DISTRIBUTION AT CHIMNEY INLET - % MICRONS | | | |
|---|---|---|---|
| Below 3 | 97.16 | Between 10 - 20 | 0.17 |
| Between 3 - 5 | 1.18 | Between 20 - 30 | 0.03 |
| Between 5 - 10 | 0.78 | Between 30-40 | 0.68 |
| | | | |

| OTHER DATA | | |
|---|---|---|
| Elevation of Breeching Line of the Duct | 33.2 m (Approx.) | PEM Chimney designer to Confirm |
| Duct Opening Size | 3.7 (W)x 7.4 (H) m x m | - |
| Chimney Shell Opening Dimensions | 4.7 (W)x 8.4 (H) m x m | PEM Chimney designer to Confirm |
| Flue Gas Pressure at Chimney Entry Level | mm WC | PEM Chimney designer to provide to BAP for Booster fan sizing |

**REMARKS:** Above mentioned parameters are for one boiler only.



**Customer / Plant: Nabinagar I** 4x250 MW TPS

| **Prop. No.:** | **Rev. 0** | | **Rev. 1** | | **Rev. 2** | | **Rev. 3** | |
|---|---|---|---|---|---|---|---|---|
| | **Sign** | **Date** | **Sign** | **Date** | **Sign** | **Date** | **Sign** | **Date** |
| **Engineer :** | Kabilash | 18.10.19 | | | | | | |
| **Reviewer :** | Manoj | 18.10.19 | | | | | | |
| **Approver :** | SKDash | 18.10.19 | | | | | | |

| | TITLE: | DOCUMENT NO.: | PE-DC-463-100-N318 |
|---|---|---|---|
| BHEL | CHIMNEY FLUE ID CALCULATION | REVISION NO.: | 01 |
| | | DATE: | 17.02.2019 |
| | 4 X 250 MW BRBCL NABINAGAR STPP (FGD PACKAGE) | SHEET: | 1 OF 1 |

# 4X250 MW BRBCL NABINAGAR STPP (FGD SYSTEM PACKAGE)

1.0 CHIMNEY FLUE ID CALCULATION

| Parameter | | Units | Design Point (VWO) | Guarantee Point(250 MW) |
|---|---|---|---|---|
| Flue gas quantity per boiler | | T/Hr | 1461.55 | 1342.89 |
| Temp. of flue gas at stack inlet | $T_{gi}$ | $^oC$ | 61.6 | 57.8 |
| Flue gas density at stack inlet | $\rho_{gi}$ | $Kg/m^3$ | 1.00502 | 1.03177 |
| Volumetric flow per boiler | Q | $M^3/s$ | 403.96 | 361.98 |
| Stack Height | H | M | 150 | 150 |
| Ambient air temp. | $T_a$ | $^oC$ | 45 | 27 |
| Relative Humidity | RH | | 60 | 60 |
| Internal flue ID | D | M | 5.35 | 5.35 |
| Flue gas velocity at stack exit | $V_{ge}$ | m/sec | 17.98 | 16.09 |

1

1

**2.0 RESULT:**

Chimney arrangement: 4 nos. Single Flue Chimneys
Height of chimney: 150 m.
Internal Flue ID : 5.35 m.
Breeching elevation: 33.2 m.
Flue velocity at exit: <18 m/s

LIGHTNING PROTECTION &EARTHING OF CHIMNEY
(SUPPLY & INSTALLATION)

| | |
|---|---|
| SPECIFICATION NO. | PES-509-02A |
| VOLUME | II B |
| SECTION | D |
| REV NO. 0 | DATE 08.02.2002 |
| SHEET 1 OF 7 | |

# GENERAL TECHNICAL REQUIREMENTS
# OF
# LIGHTNING PROTECTION OF CHIMNEY

## SPECIFICATION NO. PES-509-02A

## 1.0 GENERAL

1.1 This section includes the design, fabrication, supply, installation and testing of Lightning Protection system for the Chimney(s). The requirements of this specification shall be complied with in relation to the requirements set out in Data Sheet-A & Section-C.

1.2 The contractor's scope, besides material supply shall include complete installation of Lightning Protection System, protective coating application, and testing of the system. All materials, consumables, erection equipment etc. as required for the completion of installation and testing facilities shall be supplied.

## 2.0 CODES & STANDARDS

2.1 The latest revisions of the following codes & standards shall be applicable:

IS:2309 Code of practice for protection of buildings & allied structures against lightning.

IS:3043 Code of Practice for earthing

IS:4759 Hot-dipped galvanised coating on structural steel

IS:2629 Recommended practice for Hot-dipped galvanising for Iron & Steel.

IS:2633 Methods of Testing Uniformity of Coating on zinc-coated Articles.

IS:1731 Dimensions for Steel flats for structural & General Engineering Purposes.

IS:1752 Electroplated Coatings of Cadmium on Iron & Steel

Indian Electricity Rules, 1956,

Indian Electricity Act, 1960.

IS:4990(Part-I) Criteria for Design of Reinforced concrete Chimney.

## 3.0 DESIGN REQUIREMENTS (In case of conflict between technical specification & BOQ, BOQ shall prevail)

3.1 Lightning Protection system for the chimney shall consist of air-termination network comprising requisite number of vertical copper rods, 20mm in dia, projecting at least 1000mm above the top of the chimney and the flues, spaced uniformly along the top periphery of the outer shell of the Chimney and that of the flues. A ring of 75x6mm GI strip shall be laid along the top periphery of the flues and the Chimney, forming the

annular horizontal air terminations. The vertical air terminations shall be electrically connected (Brazed) to the horizontal air terminations, the vertical termination of the flues and those of the Chimney to the horizontal termination of the Chimney. The vertical terminations shall be spaced not more than 3m apart from each other.

3.2 The air terminations shall be secured to the top of Chimney top by an arrangement of substantially strong construction to withstand high wind pressure prevalent in the area commensurate with the height involved. All materials for the securing arrangement shall be of the same grade as the conductors and must be galvanised. The vertical air terminals at the top of the shell shall also be secured to the guard ring at the top of the shell.

3.3 A minimum of two numbers of equally spaced conductors, each consisting of 50x6mm GI strip, shall be brought down from their connecting points on the annular rings at the top of the Chimney/flues. The down-conductors originating at the top of the flues shall be brought down along the walls of the flues and electrically connected (welded) to the annular ring at the top of the outer shell of the Chimney. The down conductors (minimum two numbers) from the chimney top shall be brought down to the bottom of the Chimney all along the exterior Chimney wall.

3.4 A test link of copper black/phosphor bronze gunmetal bolted to the conductor for the purpose of isolation & testing shall be provided on each down conductor 1000mm above ground level.

3.5 Down conductors shall be cleated to the wall at an interval of 1500mm all along the length of the Chimney.

3.6 Down conductors near ground level shall be protected against mechanical injuries by means of wood-moulding or non-metallic cover. A removable cover of the same material shall be provided over the test- link for easy access.

3.7 The connection between the downconductor from the test link onwards upto an annular ring of galvanised steel running around the entire periphery of the chimney bottom shall be provided through risers which shall be of 40mm dia MS rods.

3.8 The risers shall be terminated on the annular ring of 40mm dia MS rod running around the periphery of the chimney buried 1 metre deep in the ground and clearing all foundation by at least 2 metres.

3.9 From the termination points of the downconductors on to this underground ring, mild steel rods shall terminate at test pits complete with test-links and electrodes.

3.10 The test pits at para 3.9 shall in turn be connected to the main earthmat of the power house through 40mm dia MS rod.

3.11 All joints, except for testing purposes, shall be welded type lap joints with an overlap of 100mm. The welding shall be complete around the joint and not tack welded. Electric arc welding shall be used for all joints.

3.12 After welding, two coats of anti-corrosive (red-oxide) paint followed by a coat of bituminous paint shall be applied to each joint.

3.13 The 40mm dia MS rods shall be protected against corrosion by applying a coat of barium chromate paint and two coats of bitumen below the test link.

3.14 The complete lightning protection system arrangement including air-terminations, conductors, connections, fittings etc. and materials located on the exterior within 10m from the top of the chimney shall have lead coating of 2.0mm thickness.

3.15 All exposed metal structures such as hand rails, platforms, ladders/stairs shall be connected to the downconductors through earthing band rings, of 50x6mm GI strip located 2000mm above each platform. Ladders and platforms shall be bonded together for electrical continuity. A strip of 25x3 mm GI shall be used for connection between equipment and earthing band rings. Similarly, all lighting fixtures shall be earthed.

3.16 Temporary lightning protection system shall have to be provided and maintained during the construction of chimney or till final lightning protection system is installed by the contractor free of cost and in line with IS:4998(Part-I).

3.17 For general reference and guidance, Below Ground Earthing Typical Details drg.no. PE-DG-XXX-509-0004 & drg.no.PE-DG-XXX-509-003 may be used.

## 4.0 GALVANISING

4.1 All steel strips and materials requiring galvanisation shall be hot-dip galvanised according the IS:2629 & IS:4759. Galvanising shall be done at a place where galvanising and testing facilities conforming to the relevant Indian Standards exist. The galvanising shall be smooth, clean, uniform, continuous & free from acid spots. The thickness of zinc deposit at any spot shall not be less than 75 microns. The purchaser reserves the right to measure the thickness of zinc deposit and reject any component which shows thickness of zinc at any location less than 75 microns. Should the galvanising of the sample be found defective, the entire batch of the steel will have to be re-galvanised at the seller's cost.

4.2 All nuts, bolts and washers, wherever used, shall be cadmium coated or zinc passivated, the thickness of plating conforming to the relevant Indian Standards.

## 5.0 INSPECTION & TESTING

5.1 The following stages of manufacture/installation shall be stage inspected by purchaser or his duly authorised representative:

5.1.1 Inspection of all material such as vertical air terminals, steel strips, electrodes, test links including hardware items such as bolts, nuts etc.

5.1.2 Inspection of manufacturing processes such as shearing, punching, beinding, welding, galvanising, painting etc.

5.1.3 Inspection of installation procedures

The actual inspection will be carried out as per the agreed Quality Plan.

## 5.2 TESTING

5.2.1 The supplier shall perform all tests necessary to ensure that the material and workmanship conform to relevant standards and that such tests are adequate to

demonstrate that the equipment shall comply with the requirements of this specification.

5.2.2 The tolerance in dimensions shall be in accordance with appropriate Indian Standards.

5.2.3 Forged steel below 10mm thick is subject to Magnetic Particle Testing.

6.0 DRAWINGS, DATA & DOCUMENTS

6.1 Data sheet-A of this specification gives the details of materials to be used for the Lightning Protection system for Chimney.

6.2 The tenderer shall submit his design(s) and drawings for Direct stroke Lightning Protection System of Chimneys for purchaser's evaluation/scrutiny and approval.

6.3 The contractor shall furnish his design(s) and installation drawings for approval.

6.4 The contractor shall furnish the requisite number of prints & RTF's of all drawings as specified elsewhere in this specification.

6.5 The site modifications/deviations shall be marked on the latest revision of the drawings & submitted as 'As Built' drawings to the purchaser after completion of installation.

6.6 Tenderer shall submit all filled up schedules as per Volume-III.

6.7 The tenderer shall submit reports on Type tests & Special tests conducted on lightning protection materials & accessories.

7.0 COMPLETENESS

7.1 The offer for supply and erection shall be complete in all respects & shall include all materials, tools and appliances, whether specified or not, required for the completion of the job.

7.2 Supply/arrangements of all accessories and material etc. shall be the responsibility of the contractor.

SPECIFIC TECHNICAL REQUIREMENTS

MATERIALS & SIZES

The following are the m inimum sizes of m aterial to be used for lightning protection system:

| S.No. | Material | Minimum Size |
|---|---|---|
| 1. | COPPER RODS (Lead Coated)(for vertical air Terminations projecting 1000mm above the Chimney/ flues) | 20mm dia |
| 2. GI | STRIP (for annular horizontal band ring at the top of the Chimney/flues) 75x6m | m |
| 3. GI | STRIP (for downconductor) 50x6m | m |
| 4. GI | STRIP (for earthing band ring each platform) | 50x6mm |
| 5. MS | ROD (for risers) 40m | m dia |
| 6. TEST | LINK com | patible with size at Sl.No.3 & 5 above |
| 7. MS | ROD (for annular ring buried 1 metre in the ground around the chimney) 40m | m dia |
| 8. MS | ROD (for electrodes) with Test Pits | 40mm dia |
| 9. MS | ROD (for connection between test pit and customer's earthmat) | 40mm dia |
| 10. GI | STRIP/WIRE (for connection between equipment and earthing band rings) 25x3m | m/As required |

1.0 GUARANTEED TECHNICAL PARTICULARS:

The tenderer shall fill up and submit the following technical particulars:

1.01 Name of Manufacturer :

1.02 Place and country of Manufacture :

1.03 Standards applicable :

i/ For materials & sizes :

ii/ For galvanisation/Electroplated coating :

iii/ For testing uniformity of Galvanization :

iv/ For code of practice :

v/ For hexagonal bolts, nuts washers :

vi/ For welding :

1.04 Thickness of galvanizing on steel :

1.05 Thickness of Electriplated coatings :

1.06 Thickness of Lend coating on copper :

1.07 Materials and sizes offered :

i/ Below ground conductor :

ii/ Electrodes :

iii/ Risers :

iv/ Down Conductors :

v/ Air terminations (Vertical) :

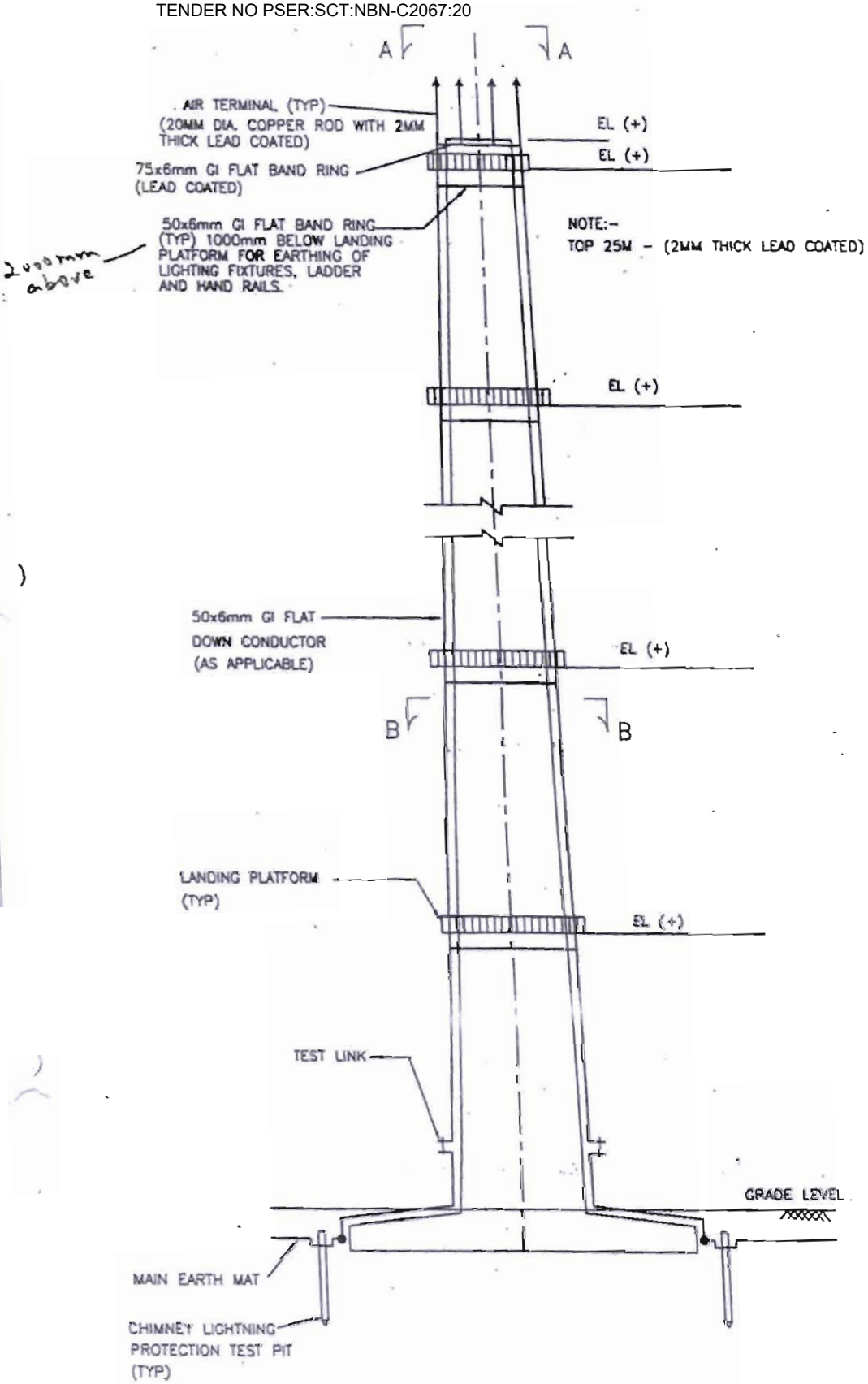
vi/ Air termination (Horizontal) :

vii/ Test Pits :

viii/ Test Links :

1.08 Whether all type test certificates furnished

1.09 Whether all schedules of Vol.III filled up and submitted.

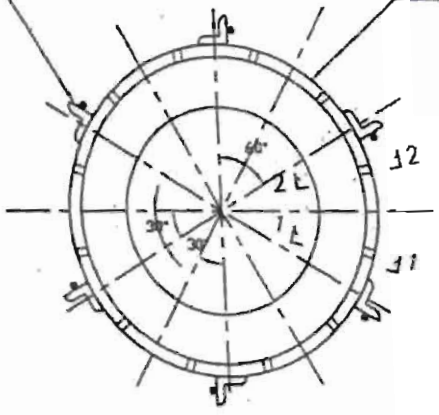



CHIMNEY (ELEVATION)

| | | |
|---|---|---|
| BHEL | [illegible] | LIGHTNING PROTN. [illegible] |
| | BHARAT HEAVY ELECTRICALS LIMITED<br>PROJECT ENGINEERING MANAGEMENT<br>NEW DELHI | DRG. No.<br>PE-DG-XXX-509-0003<br>SHEET 1 OF 4 REV. |

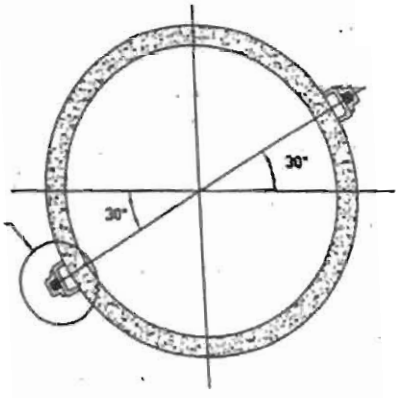
AIR TERMINAL (TYP) (20MM DIA. COPPER ROD WITH 2MM THICK LEAD COATING)

75X6 G.I. FLAT BAND RING-LEAD COATED (HORIZONTAL AIR TERMINATION)




SECTION A-A

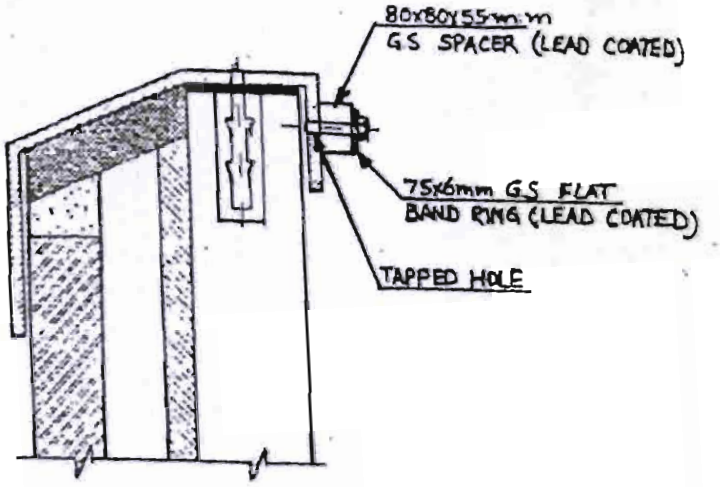
SEE DETAIL-'Y'



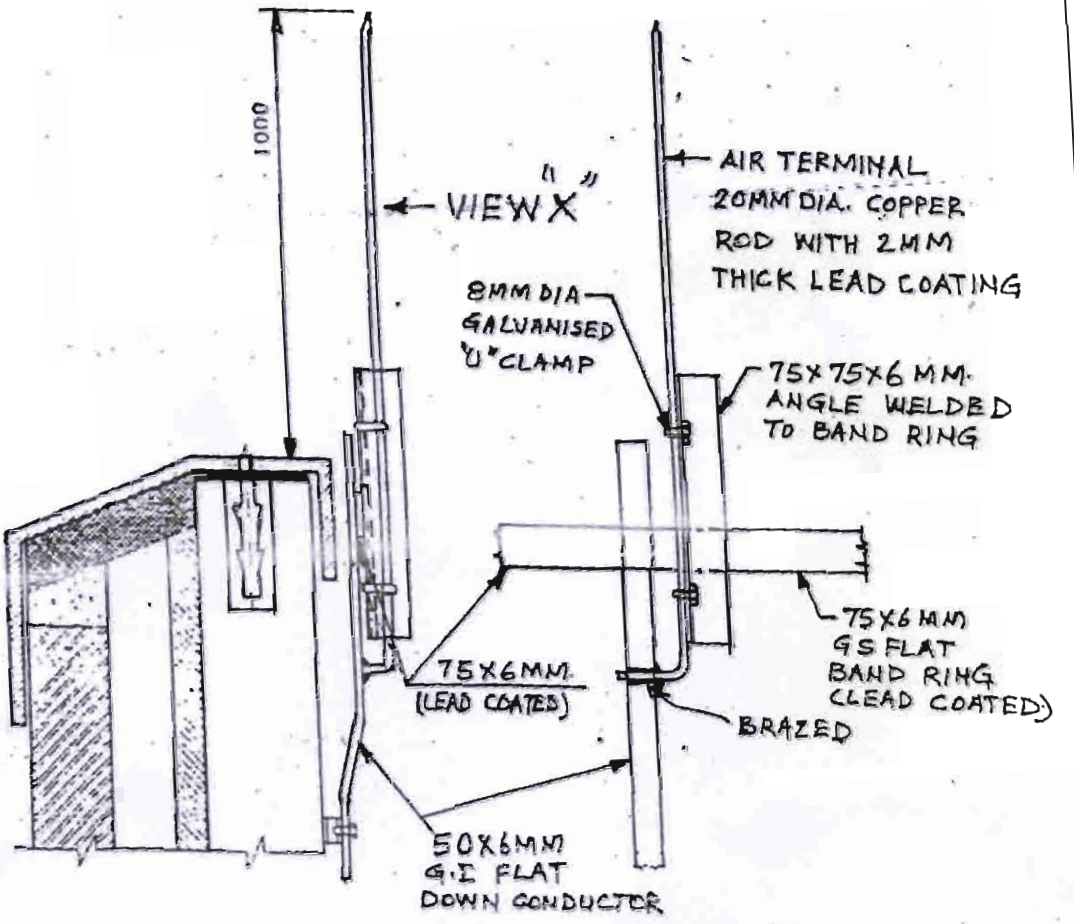

SECTION B-B

NOTE:-
TOP 25M OF CHIMNEY SHALL HAVE A LEAD COATING OF 2MM THICKNESS.

| | | |
|---|---|---|
| | BHARAT HEAVY ELECTRICALS LIMITED<br>PROJECT ENGINEERING MANAGEMENT<br>NEW DELHI | DRG. No. PE-DG-XXX-509-0003<br>SHEET 2 OF 4 REV. 00 |



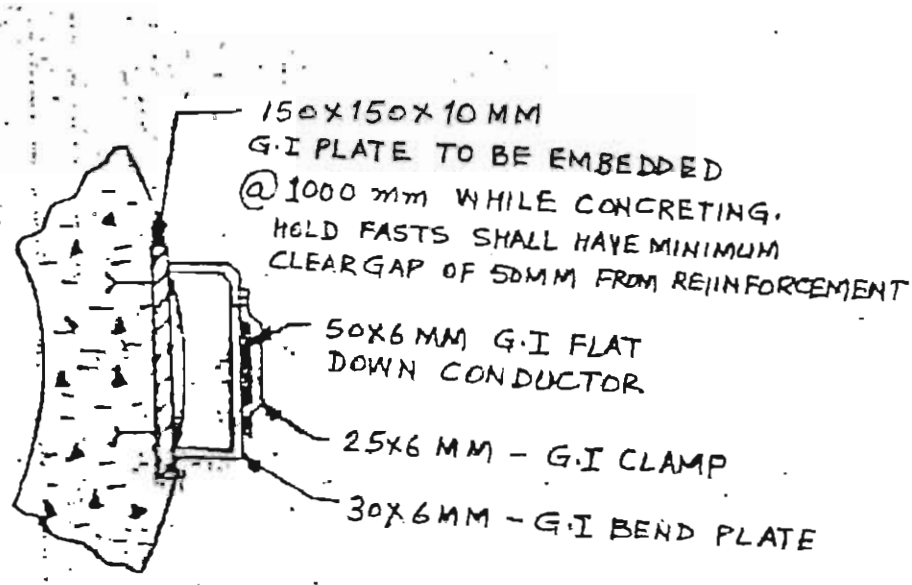

SECTION 1-1



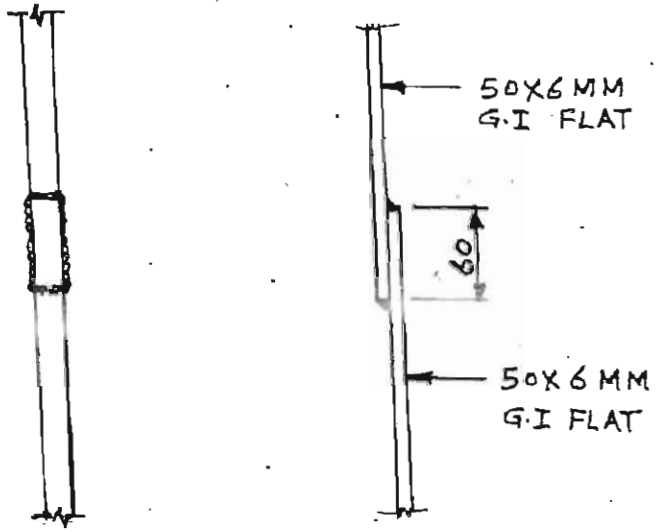

SECTION 2-2

VIEW- "X"

| | | |
|---|---|---|
| BHARAT HEAVY ELECTRICALS LIMITED<br>PROJECT ENGINEERING MANAGEMENT<br>NEW DELHI | DRG. No.<br>PE-DG-XXX-509-0003 | |
| | SHEET 3 OF 4 | REV. 00 |




## DETAIL-"Y"




## TYPICAL WELDED JOINT

| | | |
|---|---|---|
| | | |
| BHARAT HEAVY ELECTRICALS LIMITED<br>PROJECT ENGINEERING MANAGEMENT<br>NEW DELHI | DRG. No.<br>PE-DG-XXX-509-0003 | |
| | SHEET 4 OF 4 | REV. 00 |

TENDER NO PSER:SCT:NBN-C2067:20

TENDER NO PSER:SCT:NBN-C2067:20

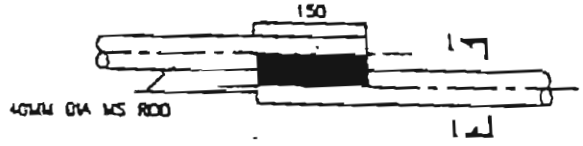
# BELOW GROUND EARTHING TYPICAL DETAILS

DRG. NO. PE-DG-~~XXX~~-509-0004



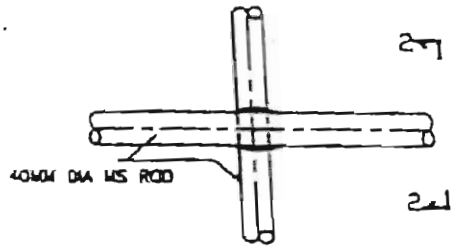
TENDER NO PSER:SCT:NBN-C2067:20

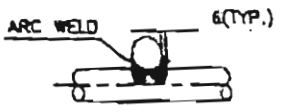
LAP JOINT



SECTION 1-1

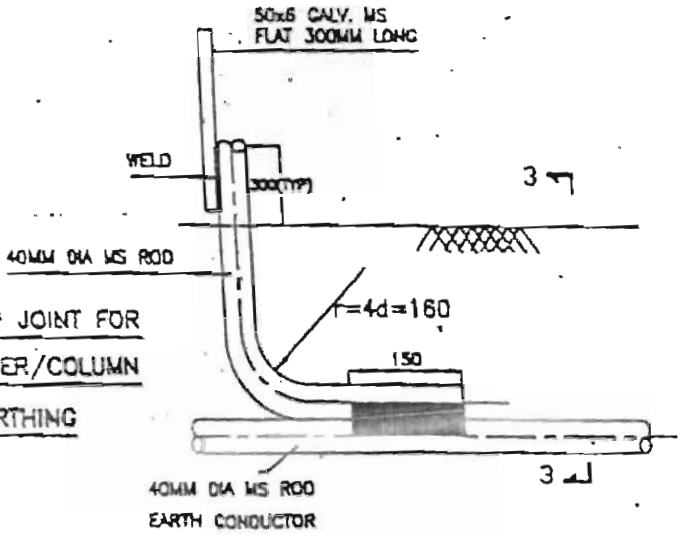
CROSS JOINT

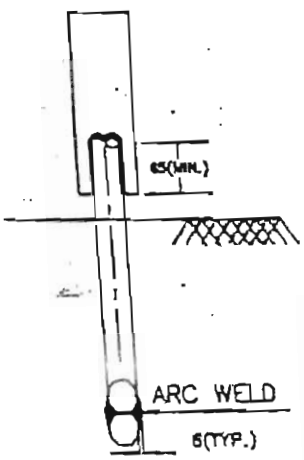



SECTION 2-2

LAP JOINT FOR RISER/COLUMN EARTHING




SECTION 3-3

## WELDED JOINTS

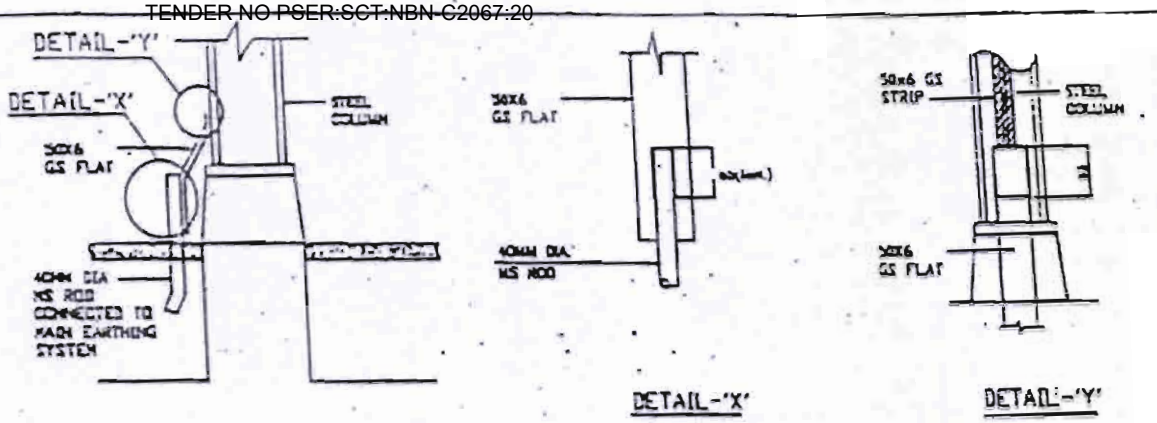
NOTES :-

ALL DIMENSIONS ARE IN MM.

BHEL DRAWING No.

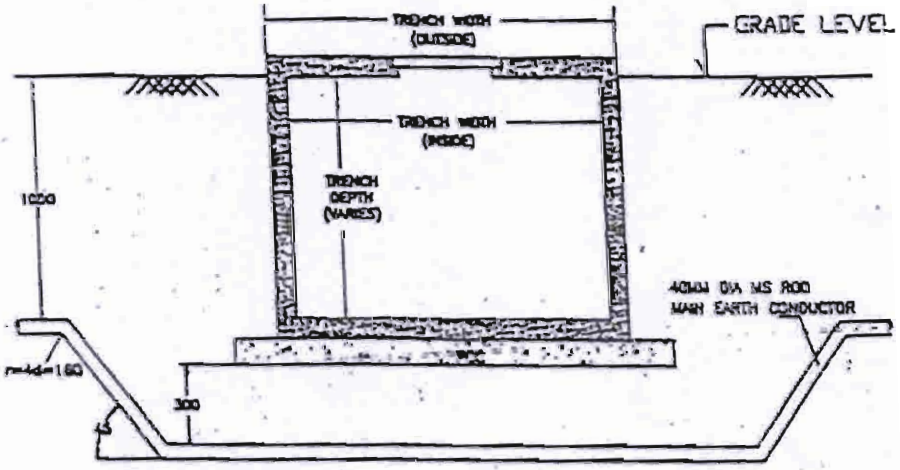
PE-DG-XXX-509-0004

## BELOW GROUND EARTHING TYPICAL DETAILS

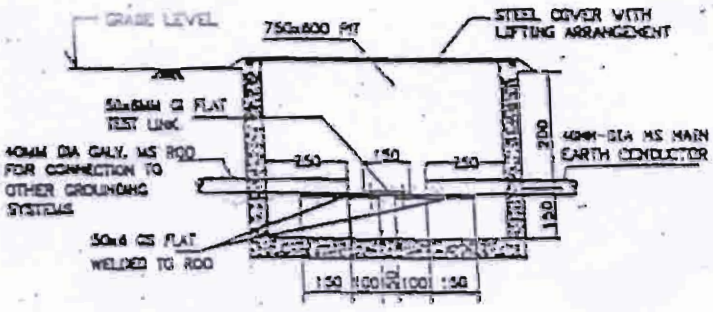



DETAIL-'X' DETAIL-'Y'

## COLUMN EARTHING




## TRENCH CROSSING




Concrete cover

## TEST-LINK

(PROVIDED FOR CONNECTION BETWEEN VARIOUS GROUNDING SYSTEMS)

NOTES :-

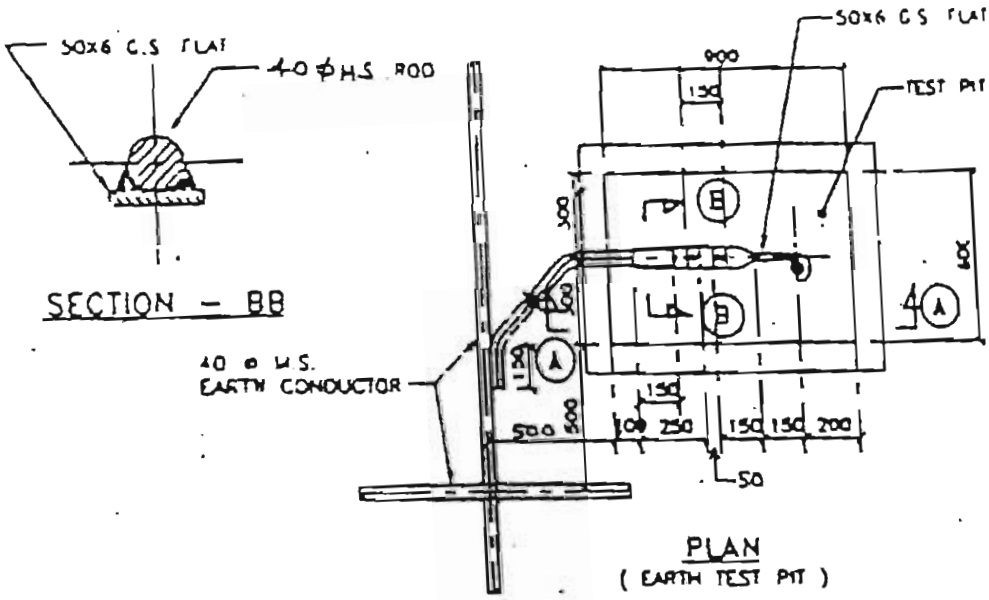
ALL DIMENSIONS ARE IN MM.

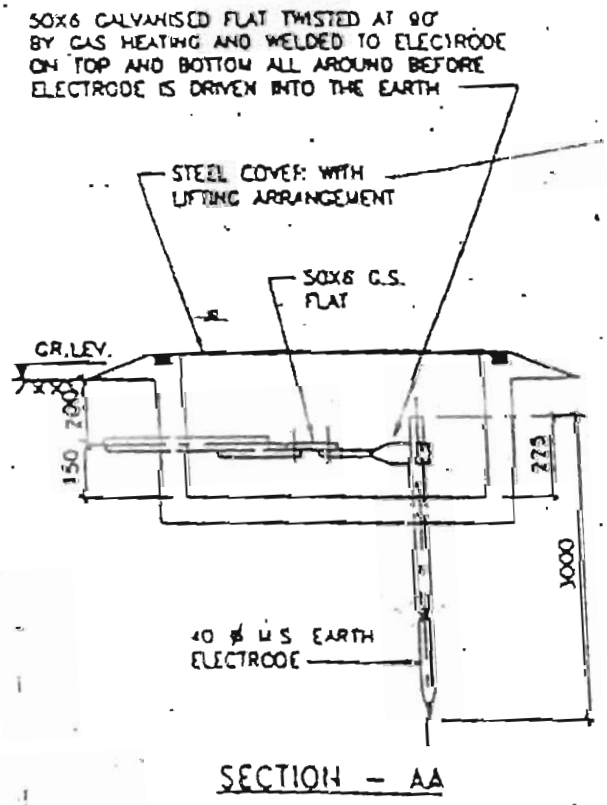
BHEL DRAWING No.

PE-DG-XXX-503-0004

# BELOW GROUND EARTHING TYPICAL DETAILS

TENDER NO PSER:SCT:NBN-C2067:20




concrete cover.

SECTION - AA

NOTE: ALL DIMENSIONS ARE IN MM.

4

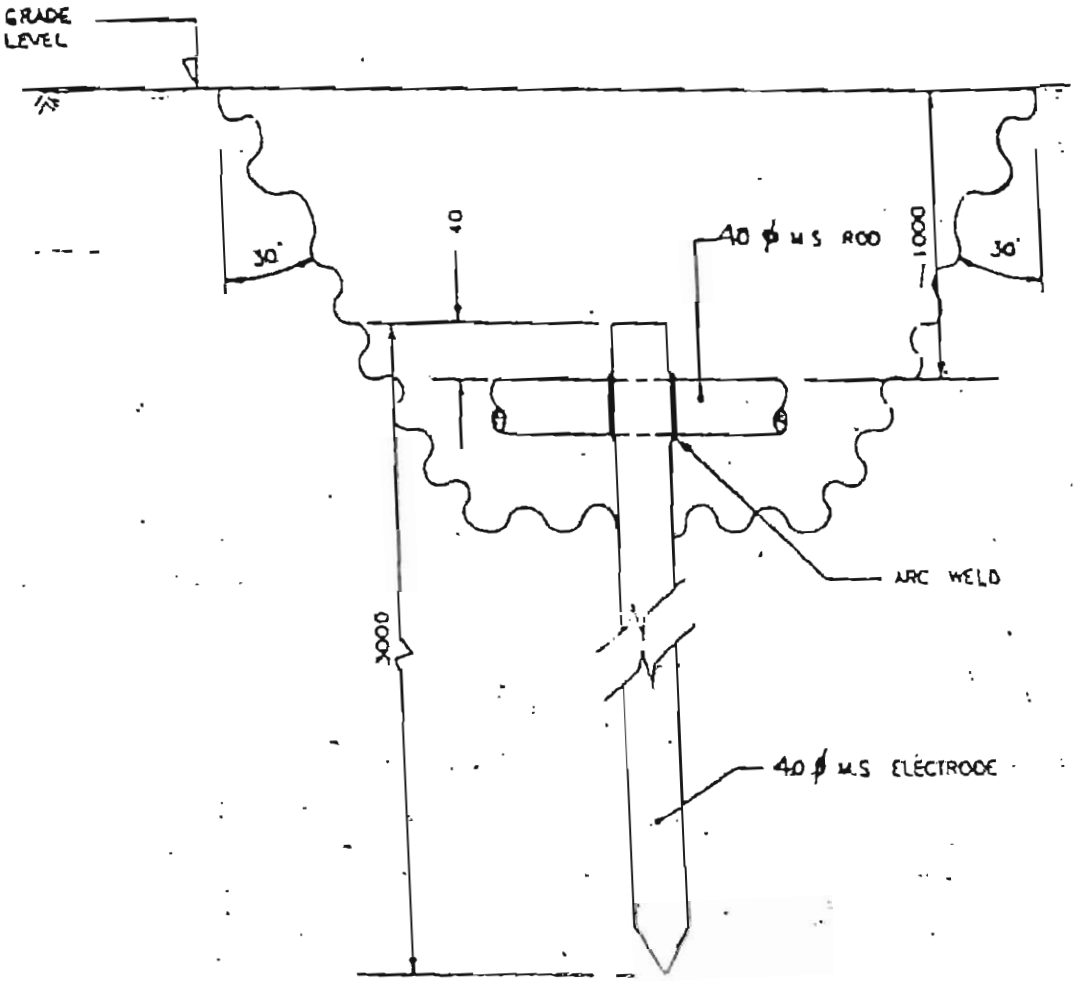
BHEL DRAWING NO.

PE-DG-[illegible]-309-0004

# BELOW GROUND EARTHING TYPICAL DETAILS

SHEET 4 OF 8

TENDER NO PSER:SCT:NBN-C2067:20




GROUND ELECTRODE

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

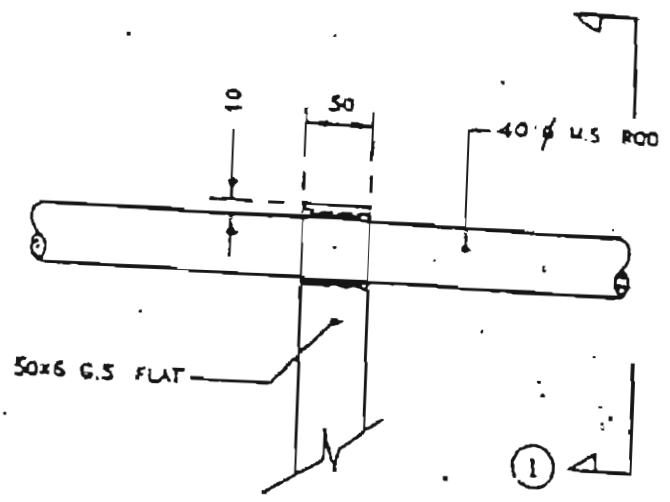
27

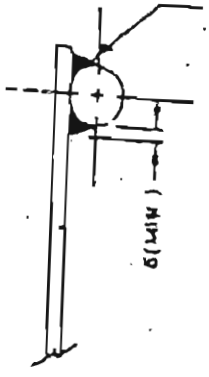
BELOW GROUND EARTHING
TYPICAL DETAILS

BHEL DRAWING No.

PE-DG-XX-509-0004

TENDER NO PSER:SCT:NBN-C2067:20




SECTION – (1)

CROSS JOINT
BETWEEN M.S. ROD & G.S FLAT

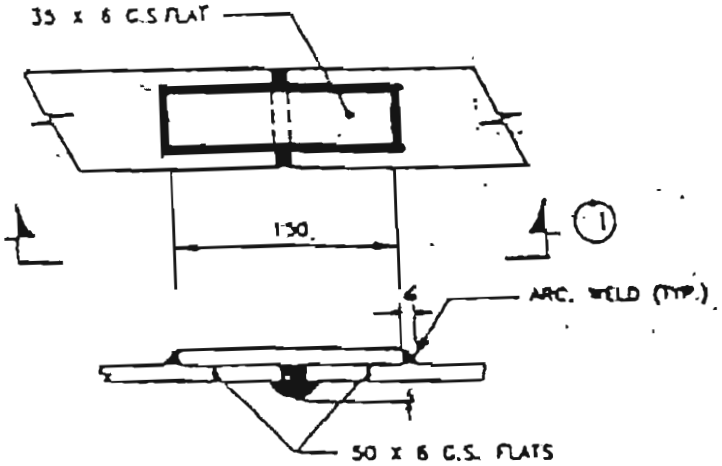
NOTE:-
1. ALL DIMENSIONS ARE IN MM.

BELOW GROUND EARTHING
TYPICAL DETAILS

BHEL DRAWING No.
PE-DG-XXX509-0004

SHEET 6 OF 9

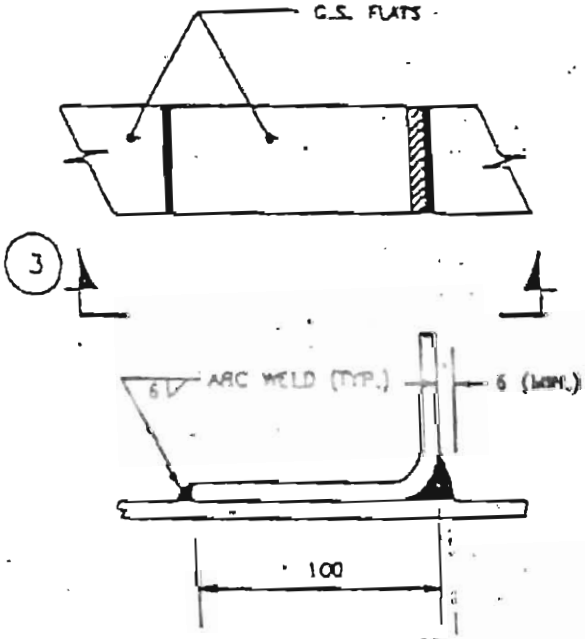
TENDER NO PSER:SCT:NBN-C2067:20




SECTION – (1)

LAP JOINT

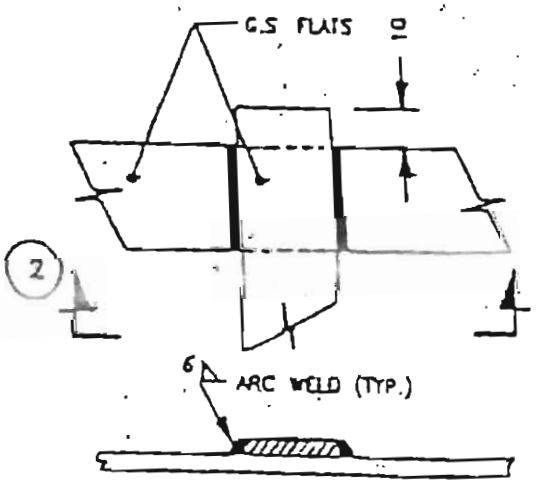
BETWEEN G. S. FLATS




SECTION – (3)

ANGULAR JOINT

BETWEEN G. S. FLATS




SECTION – (2)

CROSS JOINT

BETWEEN G. S. FLATS

24

BELOW GROUND EARTHING

TYPICAL DETAILS

TEL DRAWING No.

PE-DG-XXX-509-0004

SHEET 7 OF 8

TENDER NO PSER:SCT:NBN-C2067:20

TENDER NO PSER:SCT:NBN-C2067:20

## NOTES:-

1. WELDING OF GALVANISED FLAT/MS RODS SHALL BE CARRIED OUT AS FOLLOWS:
   a) CLEANING OF WELD AREA WITH WIRE BRUSH.
   b) REMOVAL OF GALVANISATION COATING IN THE WELD AREA.
   c) WELDING OF CONDUCTORS AS PER DETAILS SHOWN IN THIS DRAWING BY ELECTRIC ARC WELDING PROCESS USING LOW HYDROGEN CONTENT WELDING ELECTRODES.
   d) NATURAL COOLING OF WELDED JOINT.
2. EARTH CONDUCTOR SHALL BE ROUTED BELOW ROADS/ TRENCHES WITH MINIMUM CLEARANCE OF 300MM.
3. CIVIL DETAILS OF EARTH PITS/ TEST PITS ARE INDICATIVE. ACTUAL DETAILS SHALL BE SHOWN IN CIVIL DRAWINGS.
4. MINIMUM DEPTH OF BURIAL OF EARTH CONDUCTOR SHALL BE 1000 MM.

NOTES :-
ALL DIMENSIONS ARE IN MM.

BIPUS PIT

BELOW GROUND EARTHING
TYPICAL DETAILS

BHEL DRAWING No.
PE-DG-XXX-509-0004

SHEET 8 OF 8

TENDER NO PSER:SCT:NBN-C2067:20

FORM No. PEM - 6068-0

| | TITLE CHIMNEY LIGHTING | SPECIFICATION NO. PES-558-03 |
|---|---|---|
| | | VOLUME II B |
| | | SECTION D |
| | | REV. NO. 1 DATE 7.2.95 |
| | | SHEET 1 OF 7 |

# GENERAL TECHNICAL REQUIREMENTS

# OF

# CHIMNEY LIGHTING

## SPECIFICATION NO. PES-558-03 REV-01

| | TITLE CHIMNEY LIGHTING | SPECIFICATION NO. PES-558-07 |
|---|---|---|
| | | VOLUME II B |
| | | SECTION D |
| | | REV. NO. 1 DATE 7.2.95 |
| | | SHEET 2 OF 7 |

1.0 GENERAL

1.1 This specification covers the following :

- Engineering of lighting system including the associated power distribution system for chimney.
- Design, manufacture, supply, storage at site, testing of all necessary equipment such as lighting luminaries, lamps, wires, conduits, wiring accessories and any other equipment and material as would be found necessary for the satisfactory execution/ completion of the job.
- Erection, testing and commissioning of the lighting system for chimney.
- Temporary warning lights shall be provided during the course of work for heights above 45m free of cost.

2.0 CODES & STANDARDS

2.1 Unless otherwise specified, the following codes & standards are applicable. In all cases latest revision of codes shall be referred to.

| Indian Standards | Title |
|---|---|
| IS 418 | Tungsten flament general service electric lamps. |
| IS 732 | Code of practice for electric wiring installation (system voltage not exceeding 650 V) |
| IS 5133 (Part-I) | Boxes for enclosure of electrical accessories steel & cast iron boxes. |
| IS 9537 | Hot dip galvanised conduit. |
| IS 1913 | General Safety requirements for electric lighting fitting. |
| IS 1947 | Specification for flood lights. |
| IS 9900 | High pressure mercury Yapour Lamp. |
| IS 3043 | Code of practice for earthing. |
| IS 9974 | High pressure sodium vapour Lamps. |

| | TITLE CHIMNEY LIGHTING | SPECIFICATION NO. TES-558-03 |
|---|---|---|
| | | VOLUME II B |
| | | SECTION D |
| | | REV. NO. 1 DATE 7.2.95 |
| | | SHEET 3 OF 7 |

IS 3528 Water proof electric lighting fitting.

IS 694 PVC insulated cables for working voltages up to & including 1100 V.

Indian Electricity Rules -1956.
International Civil Aviation Code.

3.0 **DESIGN REQUIREMENTS**

3.1 **Lighting luminaries**

3.1.1 Twin obstruction luminaire for aviation lighting shall be used having aluminium alloy casting body with separate galleries to take two specially designed red prismatic glass domes to give a symmetrical light distribution with maximum intensity 10 degrees above horizontal. Two porcelain Bayonet caplamp holders for 100 watt incandescent lamps shall be provided. Approved weather proof paint shall be provided.

3.1.2 Alternatively Neon lamp type Luminaire shall also be quoted.

3.1.3 The obstruction lights shall be fixed lights, red in colour, having an intensity sufficient to ensure conspiquity considering the intensity of adjacent lights and general level of illumination against which they would normally be viewed. In no case, the intensity shall be less than 10 candles of red lights.

3.1.4 Flood light shall be outdoor type consisting of light weight die cast aluminium alloy housing, heat resistant and toughened glass cover with synthetic rubber gasket, reflector and mounting bracket. The luminaries shall be suitable for 1x250 W High pressure Mercury Vapour lamp (HPMV) with suitable lamp holder, ballast, power factor improvement capacitor, mounting box for accessories and connector block & fuses duly pra-wired.

3.1.5 Alternatively flood lights with 150 W High Pressure sodium vapaur lamp (HPSV) HPSV lamp shall be provided with external igniters and rapid restart facility.

3.2 **Arrangement of lights**

3.2.1 The number and arrangement of lights at each platform to be provided shall be such that the obstruction is indicated from every angle in azimuth. Number of obstruction luminaire at each platform shall not be less than four.

TENDER NO PSER:SCT:NBN-C2067:20



3.2.2 The lights shall be placed between 1.5 metres and 3 metres below the top of chimney.

3.2.3 When the top of the chimney is more than 45metres above the level of the surrounding ground, intermiate lights shall be provided for each additional 45metres or fraction thereof.

3.2.4 Four (4) Nos. flood lights shall be provided at the lowest platform of chimney for illuminating the surrounding of chimney.

3.3 **Power Distribution Scheme**

3.3.1 Lighting system load shall be supplied from A.C. Emergency lighting board. From the outgoing of A.C. ELDB, PVC armoured cable of suitable size shall emanate for feeding supply to lighting panel for chimney.

3.3.2 The contractor shall install lighting panel to be supplied by the purchaser.

3.3.4 A.C. ELDB shall be supplied & erected by the purchaser. Inter-connecting power cable between A.C. ELDB and lighting panel shall be supplied and installed by the purchaser. However, necessary provision shall be made by the chimney vendor in his civil works near the chimney for installation of above cable.

3.4 **Method of wiring**

3.4.1 From A.C. ELDB to lighting panel for chimney 650/1100 V grade, PVC insulated, PVC sheathed, armoured cable of aluminium conductor shall be installed. From lighting panel further distribution to lighting luminaries shall be done with 650 V/1100V grade, Single core ,stranded copper conductor, PVC insulated, unsheathed wires of minimum 4mm sq in conduits fixed on the chimney wall.

3.4.2 Each circuit from lighting panel shall be taken in a separate conduit.

3.4.3 The minimum acceptable copper conductor size for connecting lighting fixtures shall be 4 sq.mm. or more depending upon the voltage drop consideration.

3.4.4 Minimum conductor size shall be such that the voltage drop to the farthest lighting point shall not exceed 2.5% of 240 V.

3.4.5 The aviation obstruction lights/flood lights shall be balanced on all the three phases to the extent possible.

TENDER NO PSER:SCT:NBN-C2067:20

3.5. **Conduits**

3.5.1 Conduits (Heavy gauge) & junction boxes, shall be hot dip galvanised type as per relevant IS. No conduit less than 20mm diameter shall be used. Junction boxes/pull boxes shall be made from 1.6mm thick galvanised sheet steel and shall incorporate terminal block for termination of incoming and outgoing cables. Junction boxes to be used outdoor shall be weather proof type with gasket conforming to degree of protection IP 55.

3.5.2 Conduit accessories/ fittings shall be as per relevant IS.

3.6 **Earthing**

A separate G.I. wire of 14 SWG shall be used for earthing the lighting fittings, lighting panels as per IE Rules & IS 3403. The contractor shall connect this earthing system to main earthing mat provided by the purchaser . Main earthing mat shall be located near the chimney.

3.7 For other general reqts. of Lighting design, refer to the enclosed "Lighting Notes & Details" (Dg No. PE-DG-XXX-558-0004).

4.0 **TESTING & INSPECTION**

4.1 Standard quality plan (QP) for lighting system is enclosed in VOL III. Bidder to confirm compliance to this quality plan by signing every page of it.

4.2 All equipment shall comply with the type and routine tests as prescribed in the relevant standards. Certificates of type tests shall be furnished with the tender. The vendor shall furnish certified test reports for all routine tests before the equipment is dispatched.

4.3 Test at Site: The vendor, in the presence of the customer shall subject the installation to the following tests.

a) Insulation resistance test.

b) Testing of earth continuity path connections.

c) Complete operational tests on the whole of the installation.

4.4 Field quality plan (FQP) for quality checks to be observed at site during erection, testing & commissioning shall also be furnished by vendor alongwith offer as per standard BHEL format.

## 5.0 SPARE PARTS

Recommended list of spares for commissioning and for operation and maintenance of the lighting system for a period specified in data sheet -A shall be furnished. The vendor shall furnish separate price and list of the same. Unit rates shall also be furnished in addition to total price.

## 6.0 GUARANTEED PERFORMANCE REQUIREMENTS

The vendor shall guarantee satisfactory performance of equipment supplied under all conditions & requirement as laid down by this specification.

## 7.0 DRAWINGS & DATA

7.1 Drawings & data to be furnished with the offer

a) Filled in Data Sheet B.

b) Technical leaflets of luminaires offered.

7.2 Drawings & data to be furnished after award of contract

a) Design calculation for luminaries.

b) Design calculation for selection of lighting wires.

c) Lighting Layout plan showing lighting fixtures, conduit routing, conduit Size, cable size etc.

d) Fixing and mounting details of luminaires, conduits, junction boxes etc.

e) Test certificates for all equipment .

f) General arrangement drawing of equipment supplied.

g) Manufacturer catalogues/literature.

h) Field quality plan

i) As built drawings

FORM No. PEM - 0000-0

| | TITLE CHIMNEY LIGHTING | SPECIFICATION NO. TES-5 58-03 |
|---|---|---|
| | | VOLUME II B |
| | | SECTION D |
| | | REV. NO. 1 DATE 7.2.95 |
| | | SHEET 7 OF 7 |

8.0 OPERATION AND MAINTENANCE MANUAL

Operation and maintenance manual shall contain the followings :

a) Technical Data Sheet.

b) Instruction for maintenance for various lighting equipment.

FORM No. PEM - 6000-0

| | TITLE | SPECIFICATION NO. PE |
|---|---|---|
| BHEL | DATA SHEET A<br>CHIMNEY LIGHTING | VOLUME II B<br>SECTION A<br>REV. NO. 0 DATE<br>SHEET 1 OF 1 |

| | | | |
|---|---|---|---|
| 1.0 | **Details of Supply System** | | |
| | a) Rated voltage | : | 415 V ± 10 %. |
| | b) Rated frequency | : | 50 Hz ± 5 %. |
| | c) Combined voltage and frequency variation | : | 10 %. (Absolute) |
| | d) System fault level at rated voltage | : | 50 kA for 0.25 sec. |
| | e) LV System grounding | : | Solidly |
| | f) Design ambient temp. | : | 50°C |
| 2.0 | Type of conduit mounting | : | Surface Mounting |
| 3.0 | Type of obstruction light | : | i) GEC ZA 750(L) NEON<br>ii) High intensity flashing white light having intensity > 200 candles & flashing freq. 40-60/min |
| 4.0 | Type of Flood light | : | 250 W HPSV lamps |
| 5.0 | Source for power | : | Normal AC & Emergency AC |
| 6.0 | Junction boxes | : | Weather-proof, Galvanised steel |
| 7.0 | Main earthing mat details | : | MS Rod 40 mm dia |
| 8.0 | No. of years for which O&M spares required | : | 3 years |

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| BHEL | DATA SHEET - B<br>CHIMNEY LIGHTING | VOLUME III |
| | | SHEET 1 OF 2 |

FORM No. PEM - 6019 B-0

INSTRUCTIONS FOR BHEL

1. In the "SPECIFICATION NO" the specification number for the subject shall be entered by DE before issue for an enquiry. The standard specification number shall not be entered.

1.0 **CONDUIT**

a) Make :

b) Size :

c) Material :

d) Applicable Standard :

2.0 Applicable Standard for Conduit accessories and fittings :

3.0 **JUNCTION BOX**
(for each type & size)

a) Make :

b) Type :

c) Material :

d) Degree of protection of enclosure :

e) Applicable Standard

4.0 **LIGHTING WIRES**

a) Make :

b) Type :

c) Conductor material :

d) Size :

e) Voltage grade :

f) Applicable Standard :

| Name of Bidder / Vendor | | | | Project |
|---|---|---|---|---|
| Revision Number | 0 | 1 | 2 | 3 |
| Signature of Bidder / Vendor / Authorised Representative | | | | |
| Date | | | | |

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| BHEL | DATA SHEET - B<br>CHIMNEY LIGHTING | VOLUME III |
| | | SHEET 2 OF 2 |

FORM No. PEM - 6019 B-0

5.0 **LUMINARIES**

a) Make :

b) Type :

c) Type of lamp holder :

d) Applicable Standard :

6.0 **LAMPS**

a) Make :

b) Type :

c) Wattage :

d) Nominal lamp voltage :

e) Light output :

f) Applicable Standard :

"SPECIFICATION NO." the specification number for a ... shall be entered by ... In th... OE befo... ...ue for an enquiry. The standard specification number shall not be entered.

FOR BHEL

| Name of Bidder / Vendor | | | | Project | |
|---|---|---|---|---|---|
| Revision Number | 0 | 1 | 2 | 3 | |
| Signature of Bidder / Vendor / Authorised Representative | | | | | BIDDER'S SEAL |
| Date | | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| BHEL | DATA SHEET - C<br>CHIMNEY LIGHTING | VOLUME II B PART D<br>SHEET 1 OF 3 |

1.0 **CONDUIT**
(for each type & size)

a) Make :

b) Type :

c) Size :

d) Applicable Standard :

2.0 **JUNCTION BOX**
(for each type & size)

a) Make :

b) Material :

c) Size :

d) Degree of protection of enclosure :

e) Applicable Standard :

3.0 **LIGHTING WIRES**

a) Make :

b) Type :

c) Voltage grade :

d) Applicable Standard :

e) Continuous current rating at design ambient :

f) Conductor

i. Material :

| Name of Bidder / Vendor | | | | Project |
|---|---|---|---|---|
| Revision Number | 0 | 1 | 2 | 3 |
| Signature of Bidder / Vendor / Authorised Representative | | | | |
| Date | | | | |

Form No. PEM-401BB-0

"SPECIFICATION NO." the specification number for ... for an enquiry. The standard specification number ... shall be entered by ... be entered.

FOR BHEL

TENDER NO PSER:SCT:NBN-C2067:20

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| | DATA SHEET - C<br>CHIMNEY LIGHTING | VOLUME II B PART D<br>SHEET 2 OF 3 |

Form No. PEM - 5018B-9

ect shall be entered by
ll not be entered.

n SPECIFICATION NO the specification number for
issue for an enquiry The standard specification number

INSTRUCTIONS
FOR SHEL

ii. Nominal cross sectional area :

iii. No. & Diameter: of wires

g) **Insulation**

i. Composition of insulation :

ii. Thickness of insulation :

iii. Tolerance on thickness of insulation :

h) Colour scheme for identification of wires :

4.0 **LUMINARIES**
(for each type)

a) Make :

b) Type :

c) Type of lamp holder :

d) Capacitor rating :

e) Weight of luminaires :

f) Applicable Standards :

5.0 **LAMPS**

a) Make :

b) Type :

c) Wattage :

| Name of Bidder / Vendor | | | | Project |
|---|---|---|---|---|
| Revision Number | 0 | 1 | 2 | 3 |
| Signature of Bidder / Vendor / Authorised Representative | | | | |
| Date | | | | |

BIDDER'S SEAL

Form No. PEM - 601884

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| BHEL | DATA SHEET - C<br>CHIMNEY LIGHTING | VOLUME II B PART D<br>SHEET 3 OF 3 |

d) Nominal lamp voltage :

e) Light ontput (lumen) :

f) Life of lamp :

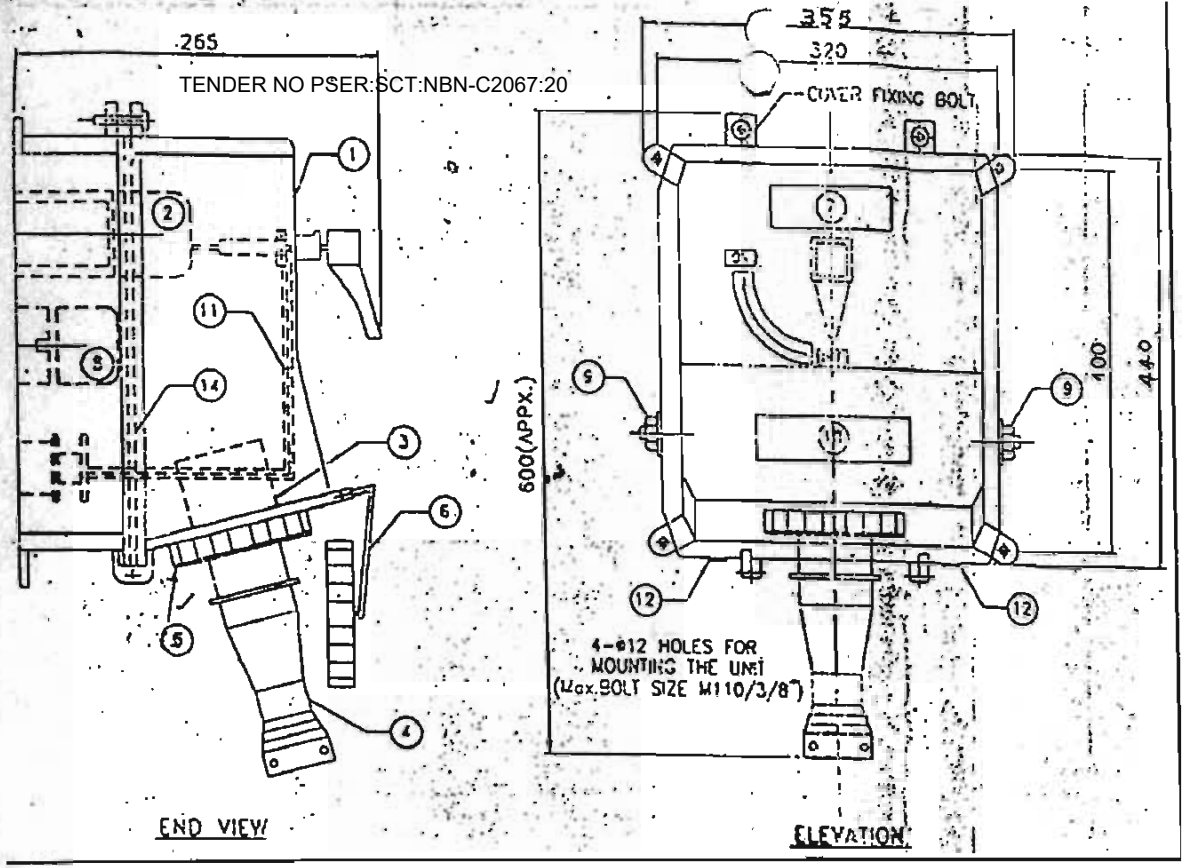
g) Applicable Standard :

INSTRUCTIONS FOR BHEL

...pumn 'SPECIFICATION NO' the specification number for ... ct shall be entered by
...ssue for an enquiry. The standard specification number ... e entered.

| Name of Bidder / Vendor | | | | Project |
|---|---|---|---|---|
| Revision Number | 0 | 1 | 2 | 3 |
| Signature of Bidder / Vendor / Authorised Representative | | | | |

TENDER NO PSER:SCT:NBN-C2067:20

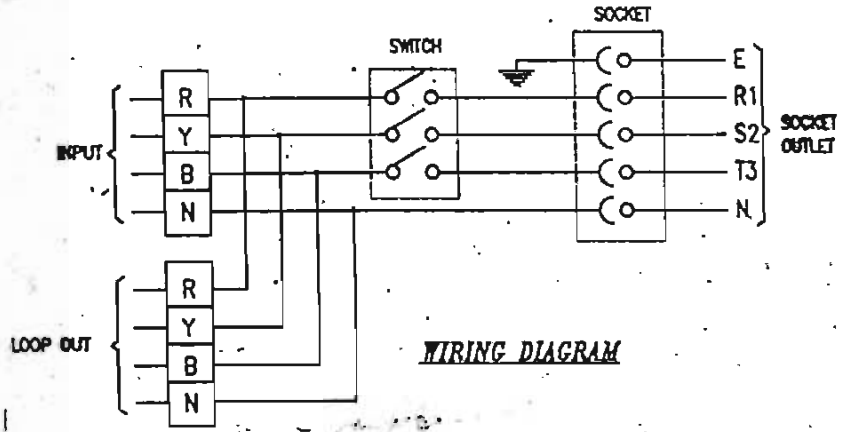



## SPECIFICATION

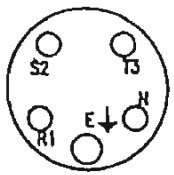
1] ALUMINIUM ALLOY HOUSING (MIN THICKNESS 3mm)
2] GE POWER CONTROL TP ON/OFF SWITCH DOUBLE BREAK TYPE SP02, AC23 CATEGORY CONFORMING TO IS-13947-3
3] BEST & CROMPTON MAKE-63A, 415V, 5 PIN TRIPLE POLE, NEUTRAL & EARTH SOCKET
4] BEST & CROMPTON MAKE-63A, 415V, 5 PIN TRIPLE POLE, NEUTRAL & EARTH PLUG
5] PLUG RING.
6] SPRING LOADED COVER FOR SOCKET OUTLET
7] NAME PLATE
8] 4 WAY STUD TYPE TERMINAL BLOCK 2 Nos. FOR LOOP IN LOOP OUT, ARRAGEMENT TO TERMINATE 3.5Cx50 sq.mm STUD TYPE BEST & CROMPTON MAKE
9] ELECTROPLATED EARTHING TERMINAL 2 Nos. COMPLETE WITH 6mm BOLT,NUT & WASHER SUITABLE FOR 14 SWG. GI. EARTHING CONDUCTOR
10] CAUTION STACKER
11] MECHANICAL INTERLOCKING ARRANGEMENT
12] DETACHABLE GLAND PLATE O TAKE 2 Nos. GLAND SUITABLE FOR 3.5x70 sq.mM. CABLES.

## NOTES

1] ALL DIMENSION ARE IM MM UNLESS OTHERWISE SPECIFIED SUBJECT TO TOLERANCE ±5mm
2] EACH UNIT PROVIDED WITH INTERNAL WIRING SIZE 16 2.5 sq.mm. CABLE
3] THE ENCLOSURE IS PAINTED WITH SHADE GREY RAL 9002 – POWER COATING
4] THE UNIT ARE SUITABLE FOR OUTDOOR USE, IP-55 AS PER IS-13947
5] SWITCH CAN NOT BE MADE 'ON' UNLESS PLUG IS INSERTED
PLUG CAN NOT BE WITHDRAWN UNLESS SWITCH IS IN OFF POSITION
6] UNIT IS MANUFACTURE BY. "BEST & CROMPTON"
7] SUITABLE CABLE GRIP SHALL BE PROVIDED




WIRING DIAGRAM




SHOWING TERMINAL POSITION

COLOUR CODED SLEVE WILL BE PROVIDED ON BOTH ENDS ON COPPER FLEBLE
R PHASE – RED COLOUR
Y PHASE – YELLOW COLOUR
B PHASE – BLUE COLOUR
NEATRAL – BLACK COLOUR

1230-001-29PE-PVE-B-073

CHIMNEY LIGHTING SPECIFICATION

| REV | DATE | DESCRIPTION |
|---|---|---|
| 01 | | |
| 02 | | |

NATIONAL THERMAL POWER CORPORATION LTD.
RIHAND 2X500MW THERMAL POWER PROJECT STAGE-II

bajaj electricals limited MUMBAI
Engineering & Projects Division.

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR, PROJECT ENGINEERING MANAGEMENT
NEW DELHI

TENDER NO PSER:SCT:NBN-C2067:20

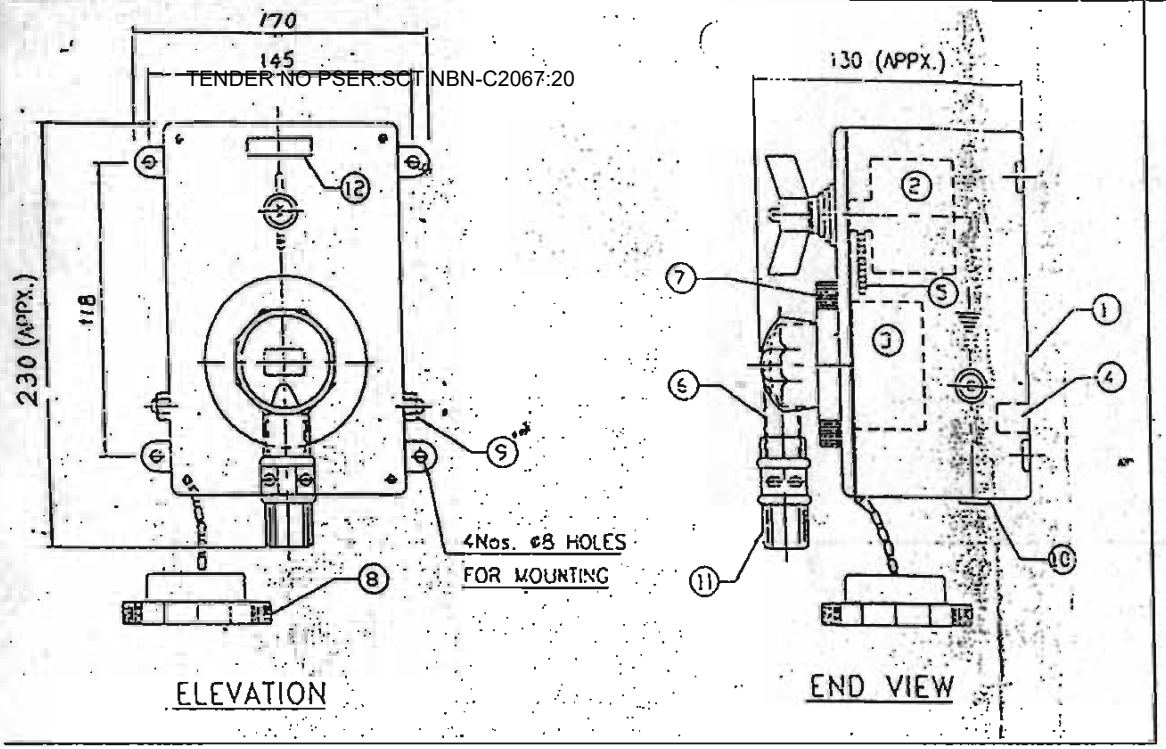
| DRN | CHKD | APPD | DATE | BHEL DWG. No |
|---|---|---|---|---|
| KBM | JS | AP | 30.06.03 | PE-V0-200-558-E073 |

TITLE: GENERAL ARRANGEMENT DWG FOR 63 A FULLY INTERLOCKED SWITCHED PLUG 63 AMPS 415 VOLTS [TYPE RC]

DWG. NO. EPBU-03-PS005-04-073

REV. 0

SHT. 1 OF 1



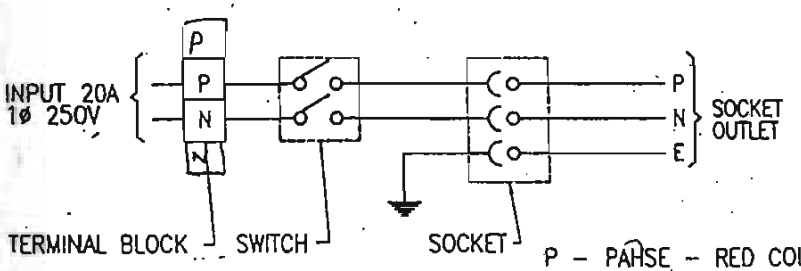

## SPECIFICATION

1] ALUMINIUM ALLOY ENCLOSURE 3mm THICK
2] 25A, 250V, DOUBLE POLE/ OFF ROTARY SWITCH AC 23 CATEGORY IS-4064 – RECOM MAKE
3] ALUMINIUM ALLOY METAL CLAD SOCKET UNIT "BEST & CROMPTON" MAKE
4] BAKELITE STUD TYPE 2 WAY TERMINAL BLOCK TO TERMINATE 2Cx4 sq.mm CABLE
5] MECHANICAL INTERLOCKING SYSTEM
6] DIE CAST ALUMINIUM ALLOY METAL CLAD PLUG AND SOCKET OF 20A, 240V, 3 PIN (P+N+E), 3rd PIN GROUNDED
7] THREADED PLUG LOCKING RING
8] SOCKET COVER WITH CHAIN FOR SOCKET OUTLET
9] EARTHING TERMINAL 2 Nos. – M6 SIZE
10] CABLE ENTRY 25mm DIA – 2Nos.
11] PVC CABLE GRIP
12] NAME PLATE

## NOTES

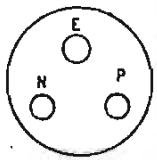
1] ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED SUBJECT TO TOLERANCE OF ±5mm
2] EACH UNIT PROVIDED WITH INTERNAL WIRING SIZE 4 sq.mm. COPPER CABLE
3] THE ENCLOSURE IS PAINTED WITH SHADE GREY RAL 9002 – POWDER COATING
4] THE UNIT ARE SUITABLE FOR OUTDOOR USE, IP-55 AS PER IS-13947
5] SWITCH CAN NOT BE MADE 'ON' ONLY WHEN PLUG IS FULLY ENGAGED WITH SOCKET. PLUG CAN NOT BE WITH DRAWN WHEN SWITCH IS ON
6] 2 Nos. CABLE ENTRY AT BOTTOM

CHIMNEY LIGHTING SPECIFICATION.




WIRING DIAGRAM
(FOR SINGLE PHASE UNIT)

P – PHASE – RED COLOUR
N – NEUTRAL – BLACK COLOUR
E – GREEN COLOUR




VIEW ON SOCKET PLUG REMOVED

| REV | DATE | DESCRIPTION |
|---|---|---|
| 01 | | |
| 02 | | |

1230-001-29PE-PVC-B-070

NATIONAL THERMAL POWER CORPORATION LTD.
RIHAND 2X500MW THERMAL POWER PROJECT STAGE-II

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR: PROJECT ENGINEERING MANAGEMENT

bajaj electricals limited MUMBAI
Engineering & Projects Division

| DRN | CHKD | APPD | DATE | BHEL DWG. No |
|---|---|---|---|---|
| VPU | IS | AP | 30.06.03 | PE-V0-200-558-E070 |

TITLE GENERAL ARRANGEMENT DWG FOR FULLY INTERLOCKED SWITCHED PLUG 20 AMPS, 250 VOLTS [TYPE RA]

DWG. NO. EPBU-03-PS005-04-070 REV 0

SHT. 1 OF 1

| | TITLE: | |
|---|---|---|
| | **LIGHTING NOTES AND DETAILS** | SPECIFICATION NO. PES-558-0004 |
| | | VOLUME - II |
| | | SECTION - C Sub Sec -II |
| | | REV.NO. 0 DATE |
| | | SHEET 1 OF |

LIGHTING NOTES AND DETAILS

SPECIFICATION NO. PES-558-0004

| | TITLE: | SPECIFICATION NO. PES-558-0004 |
|---|---|---|
| | **LIGHTING NOTES AND DETAILS** | VOLUME - II |
| | | SECTION - C Sub Sec -II |
| | | REV.NO. 0 DATE |
| | | SHEET 1 OF |

## LIGHTING NOTES

1.0 These lighting notes and details shall be read and construed in conjunction with the lighting specifications and drawings

2.0 Contractor shall develop final conduit/cable routings based on fixture location and other site conditions.

3.0 Unless otherwise shown, the mounting heights of lighting fixtures and accessories shall generally be as follows.

3.a. Lighting fixture in general areas of powerhouse, miscl. Pump house etc.

- 3.a.i. Low bay type : 3000 mm to bottom.
- 3.a.ii. Medium bay type : bet 3500 mm to 8000 mm to bottom.
- 3.a.iii. High bay type : above 8000mm to bottom.

3.b. Bracket lights over door opening : 300 mm bot of fixture above opening.

3.c. Receptacles

- 3.c.i. In control room office : 450 mm floor to center.
- 3.c.ii. Elsewhere : 900 mm floor to center.

3.d. Local switches : 1500 mm floor to center

3.e. Lighting panels : 1800 mm floor to top

4.0 All outdoor illumination fixtures unless it fed from photocell/tank-switch controlled lighting panel shall be provided with outdoor type local switches.

5.0 Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in the form of switch or fuse.

5. SEPARATE NEUTRAL WIRE SHALL BE PROVIDED FOR EACH CIRCUIT. WIRING THROUGHOUT THE INSTALLATION SHALL BE SUCH THAT THERE IS NO BREAK IN THE NEUTRAL WIRE IN THE FORM OF SWITCH OR FUSE.

6. ALL EXPOSED CONDUIT RUNS IN BATTERY ROOM, CHEMICAL FEED STATION AREA, WATER TREATMENT BUILDING ETC. SHALL BE SUITABLY PAINTED WITH ACID/ ALKALI PROOF PAINTS.

7. THE ENTIRE METALLIC CONDUIT SYSTEM SHALL BE ELECTRICALLY CONTINUOUS AND THOROUGHLY GROUNDED.

8. LIGHTING FIXTURES SHALL NOT BE SUSPENDED DIRECTLY FROM JUNCTION BOX IN THE MAIN CONDUIT RUN.

9. AC AND DC CIRCUITS SHALL NOT BE RUN IN THE SAME CONDUIT.

10. RECEPTACLES SUB-CIRCUITS SHALL BE KEPT SEPARATE AND DISTINCT FROM LIGHTING AND FAN SUB-CIRCUITS.

11. WIRES/CABLES SHALL BE SPLICED ONLY AT JUNCTION BOXES WITH RING-TONGUE LUGS OR APPROVED EQUAL.

12. FOR CABLE/WIRE NUMBERING, PVC SLEEVE WITH CABLE/WIRE TAG NUMBER OF DIFFERENT COLOUR CODE SHALL BE USED.

13. IN OUTDOOR AREAS, MAIN RUNS FROM LIGHTING PANELS SHALL BE BY MEANS OF ATVY CABLES, LAID IN TRENCHES OR DIRECTLY BURIED IN GROUND WITH PROPER PROTECTION AS PER DETAILS SHOWN.

14. WHEN BURIED CABLES CROSS ROAD/RAILWAY TRACK, ADDITIONAL PROTECTION TO BE PROVIDED IN FORM OF HUME/G.I. PIPE.

15. FLAME PROOF INSTALLATIONS SHALL BE CARRIED OUT WITH FLAME-PROOF G.I. CONDUITS AND FLAME-PROOF ACCESSORIES AND JUNCTION BOXES.

16. UNLESS OTHERWISE NOTED, THE SIZE OF CABLES, WIRES, CONDUITS, JUNCTION BOXES SHALL BE AS BELOW :-

| | | |
|---|---|---|
| NR PDS PVT LTD | LIGHTING NOTES & DETAILS | DRG. No. PE-DG-XXX-558-0004 |
| | | REV. No. 0 |
| | | SHEET 2 OF 15 |

A) C A B L E S

FROM STATION AUXILIARY SYSTEM TO MAIN LIGHTING DISTRIBUTION BOARDS : AL [redacted]PVC FRLS *

i) FROM MAIN LIGHTING DISTRIBUTION BOARDS TO 415 V NORMAL A.C. LIGHTING PANELS : AL [redacted]PVC FRLS *

ii) FROM EMERGENCY MAIN LIGHTING DIST. BOARDS (EMLDB) TO 415 V EMERGENCY A.C. LIGHTING PANELS : AL [redacted]PVC FRLS *

iii) FROM MAIN LIGHTING DIST. BOARDS (MLDB) TO 415 V AC/220 V DC EMERGENCY LIGHTING DISTRIBUTION BOARDS (DCELDB) : AL [redacted]PVC FRLS *

iv) FROM 220 V MAIN DC DISTRIBUTION BOARDS TO 415 V AC/220 V DC EMERGENCY LIGHTING DISTRIBUTION BOARD (DC ELDB) : AL [redacted]PVC FRLS *

v) FROM MCC/PMCC/DB TO RC, RD RECEPTACLES : AL HRFRLS *

vi) FROM 415 V NORMAL AC STREET AREA LIGHTING PANEL TO STREET LIGHTING POLE JUNCTION BOX : AIWY *

* SIZES OF CABLES TO BE DECIDED BY THE BIDDER.

B) WIRES

i) FROM LIGHTING PANELS TO JUNCTION BOXES : 1C, ¼ MM² Cu

ii) FROM JUNCTION BOXES TO LIGHTING FIXTURES : 1C, 2.5 MM² Cu.

iii) FROM JUNCTION BOXES TO FLOOD LIGHT FIXTURES : 2 x 2.5 MM², 1C, Cu

iv) FROM LIGHTING PANELS TO 240 V AC 5/15A, 1 PHASE RECEPTACLES & 24 V AC SUPPLY MODULES TYPE B4 : 1C, ¼ MM² Cu

v) FROM 24 V AC SUPPLY MODULES TO 24 V AC, 5A RECEPTACLES : 1C, ¼ MM² Cu

C) CONDUITS

| CABLE SIZE | CONDUIT SIZE 20 MM | 25 MM | 32MM | 40MM | 50 MM | |
|---|---|---|---|---|---|---|
| i) 10 MM² AL | - | 2 | 5 | 7 | 8 | MAXIMUM NO. OF CONDUCTORS ADMISSIBLE FOR CONDUIT |
| ii) 2.5 MM² CU | 3 | 5 | 9 | - | - | |

D) JUNCTION BOXES

| CONDUIT SIZE (MM) | JUNCTION BOX SIZE (MM) 4-WAY | 3-WAY | STRAIGHT THROUGH | 90° |
|---|---|---|---|---|
| i) 20 / 25 | 150x150x100 | 150x100x100 | 88 ϕ | 88 ϕ |
| ii) 32 / 40 | 254x200x127 | 254x200x127 | 150x150x100 | - |
| iii) 50 | 254x200x127 | 254x200x127 | 254x200x127 | - |

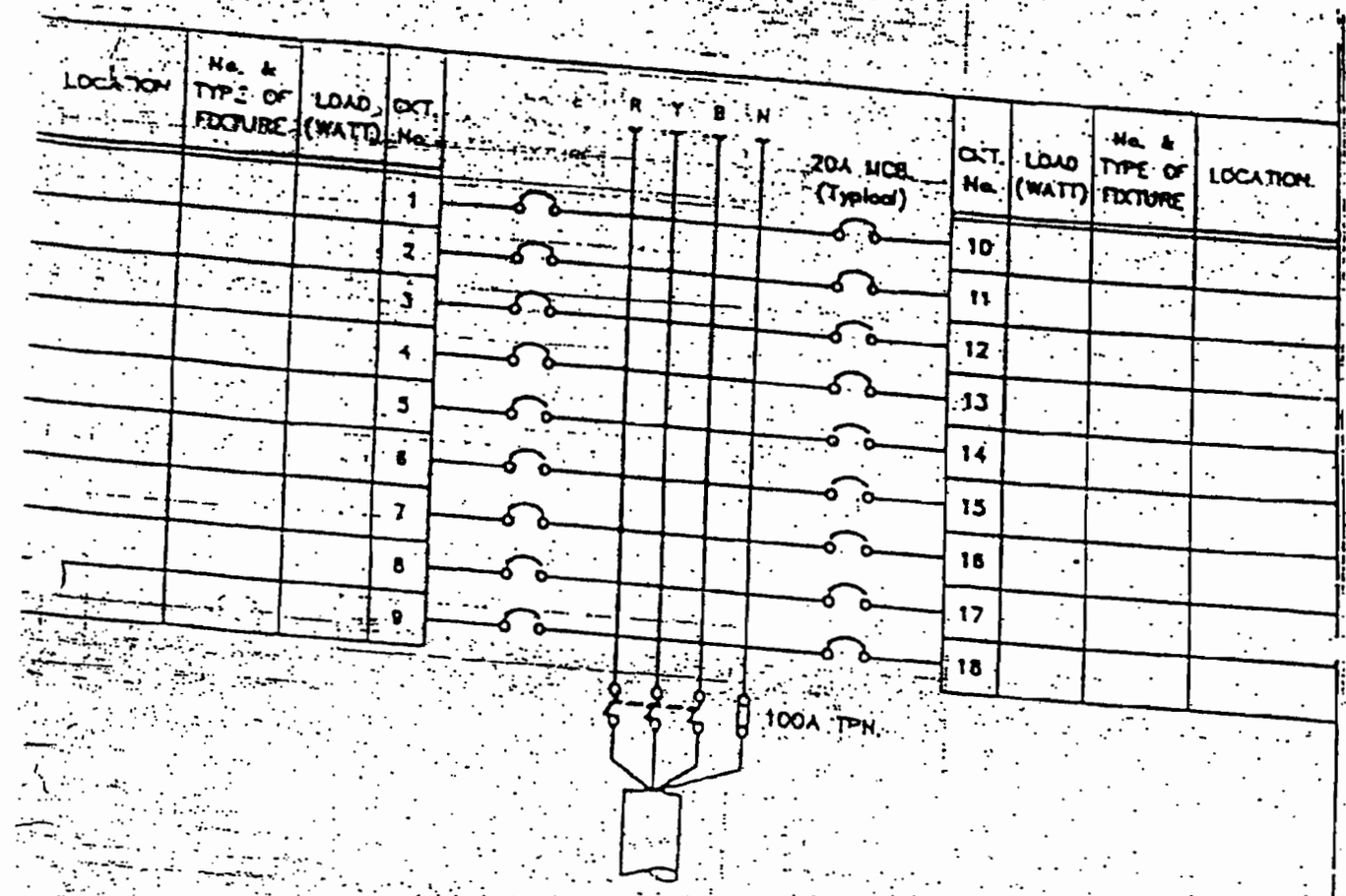
17. ALL LIGHTING PANELS/DISTRIBUTION BOARDS, JUNCTION BOXES, RECEPTACLES, FIXTURES, CONDUITS, ETC. SHALL BE GROUNDED IN COMPLIANCE WITH THE PROVISION OF I.E. RULE AND AS DETAILED BELOW :-

| | | |
|---|---|---|
| i) | LIGHTING PANELS | : 35 x 6 MM G.S. FLATS |
| ii) | DISTRIBUTION BOARDS | : 50 x 6 MM G.S. FLATS |
| iii) | FIXTURES, RECEPTACLES, SWITCHES, CONDUITS, JUNCTION BOXES ETC. | : 16 SWG G.I. WIRE |
| iv) | STREET LIGHT POLES & TOWERS FOR FLOOD LIGHTING | : 50 x 6 MM G.S. FLATS |

18. A CONTINUOUS GROUND CONDUCTOR OF 12 SWG G.I. WIRE SHALL RUN ALONG EACH CONDUIT RUN AND BONDED TO IT EVERY 600 MM.

19. THE ELECTRICAL INSTALLATION WORK SHALL MEET THE REQUIREMENTS OF INDIAN ELECTRICITY RULES, RELEVANT IS CODES OF PRACTICE & SAFETY CODES, ALL AS AMENDED UPTO DATE. IN ADITION, OTHER RULES OR REGULATIONS, AS APPLICABLE TO THE WORK SHALL BE FOLLOWED. IN CASE OF ANY DISCREPANCY, THE MORE RESTRICTIVE RULE SHALL BE BINDING.

20. TYPICAL DETAILS OF LIGHTING FIXTURES, OTHER LIGHTING SYSTEM COMPONENTS AND THEIR MOUNTING ARRANGEMENT AS SHOWN IN DRAWING NO. E : : SHEET 6 TO : ARE FOR GENERAL GUIDANCE ONLY. THE CONTRACTOR HAS TO DESIGN THE SAME FULFILLING THE REQUIREMENT OF THE SPECIFICATION.



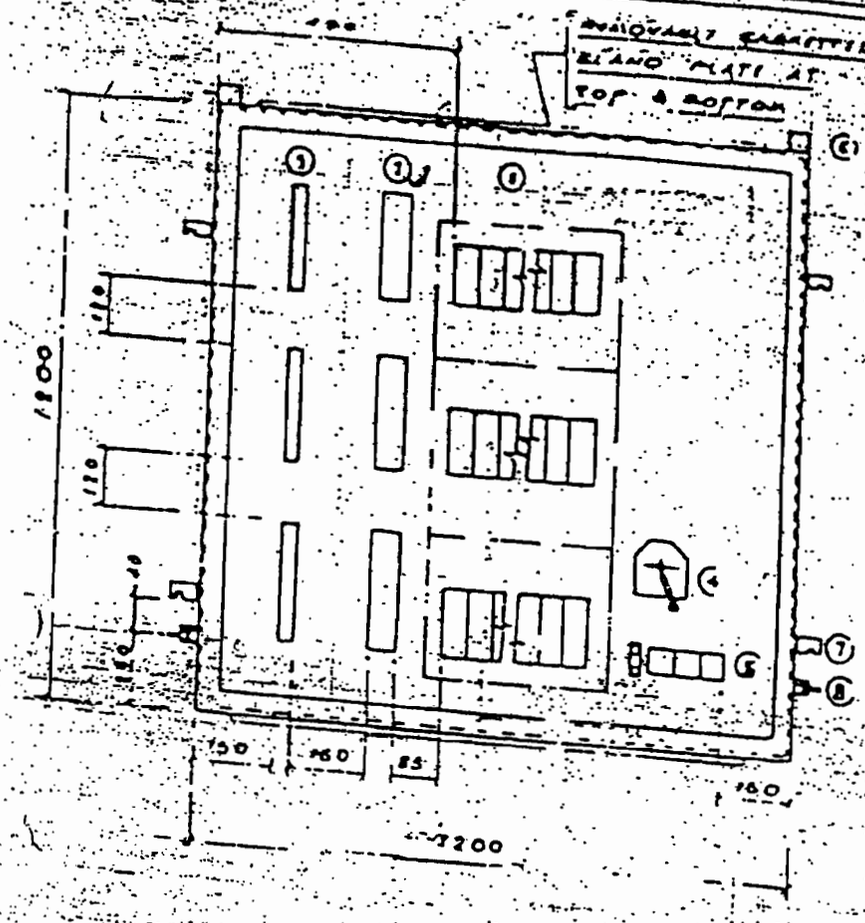

# LIGHTING NOTES & DETAILS

SLD OF 415V LTG PANEL

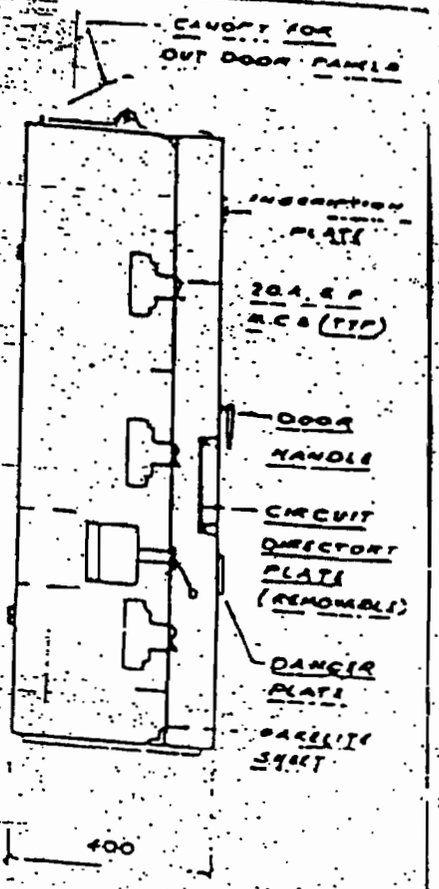
DRG. No.
PE-DG-[illegible]-558-0004

REV. No. 0

SHEET 7 OF 15




FRONT VIEW
(DOOR REMOVED)




SECTIONAL SIDE VIEW

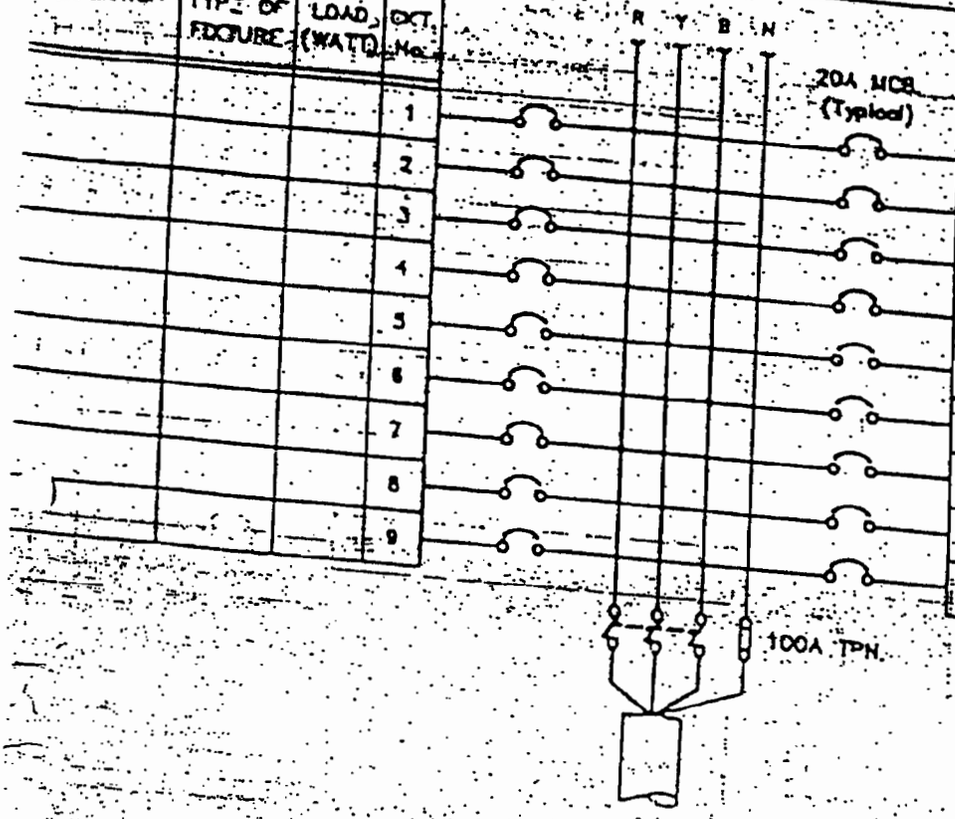
FOUNDATION PLAN

LEGEND

- MINIATURE CKT BKR.
- (1) PHASE TERMINALS STUD
- (1) NEUTRAL BUS WITH NUT, BOLT & WASHER
- (4) ISOLATOR
- (5) TERMINAL BLOCK
- (6) LIFTING LUG
- (7) FIXING LUG
- (8) EARTHING STUD WITH NUTS

| | |
|---|---|
| LIGHTING NOTES & DETAILS<br>G.A. OF LIGHTING PANEL | DRG. No.<br>PE-DG-XXX-558-0004 |
| | REV. No.<br>0 |
| | SHEET 6 OF 15 |

| LOCATION | No. & TYPE OF FIXTURE | LOAD (WATT) | CKT. No. |
|---|---|---|---|
| | | | 1 |
| | | | 2 |
| | | | 3 |
| | | | 4 |
| | | | 5 |
| | | | 6 |
| | | | 7 |
| | | | 8 |
| | | | 9 |



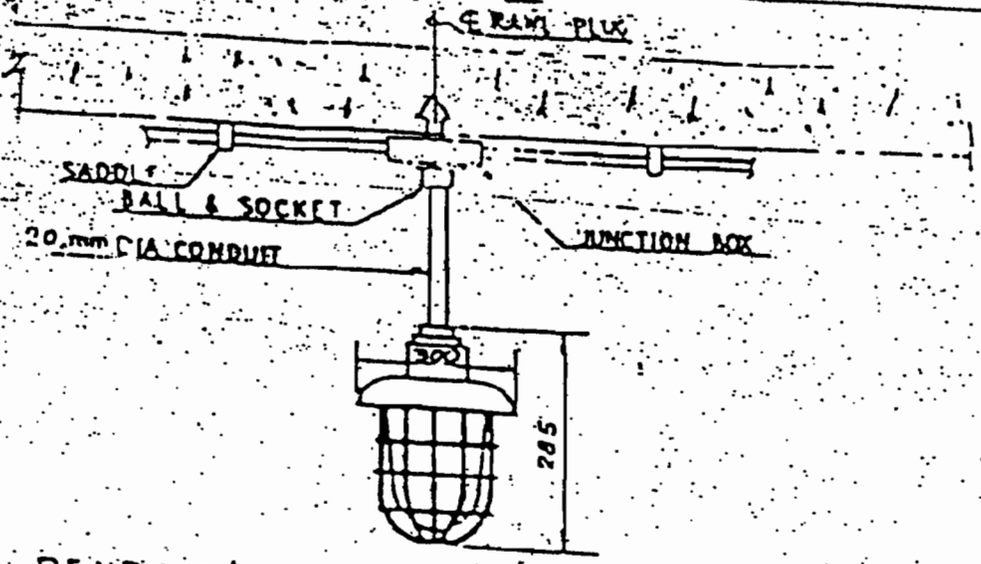

| CKT. No. | LOAD (WATT) | No. & TYPE OF FIXTURE | LOCATION |
|---|---|---|---|
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

# LIGHTING NOTES & DETAILS
## SLD OF 415V LTG PANEL

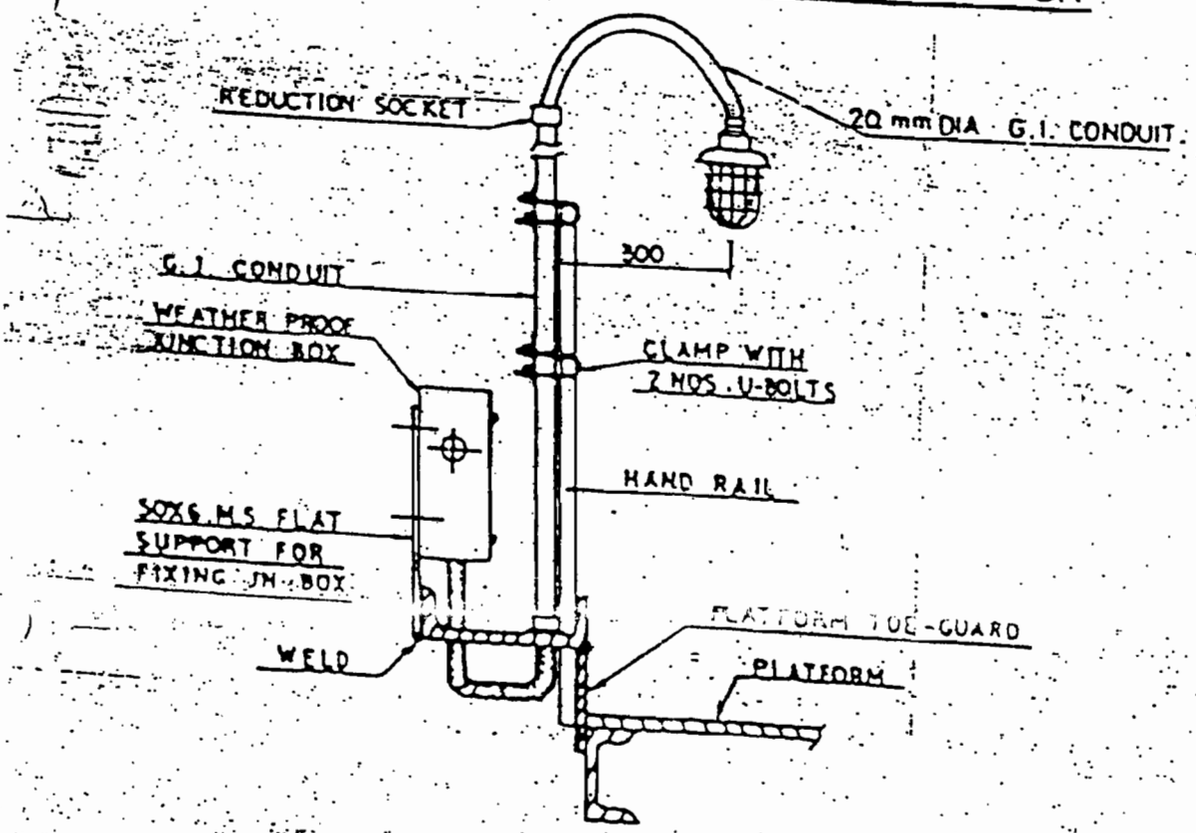
DRG. No.
PE-DG-[illegible]-558-0004

REV. No. 0

SHEET 7 OF 15

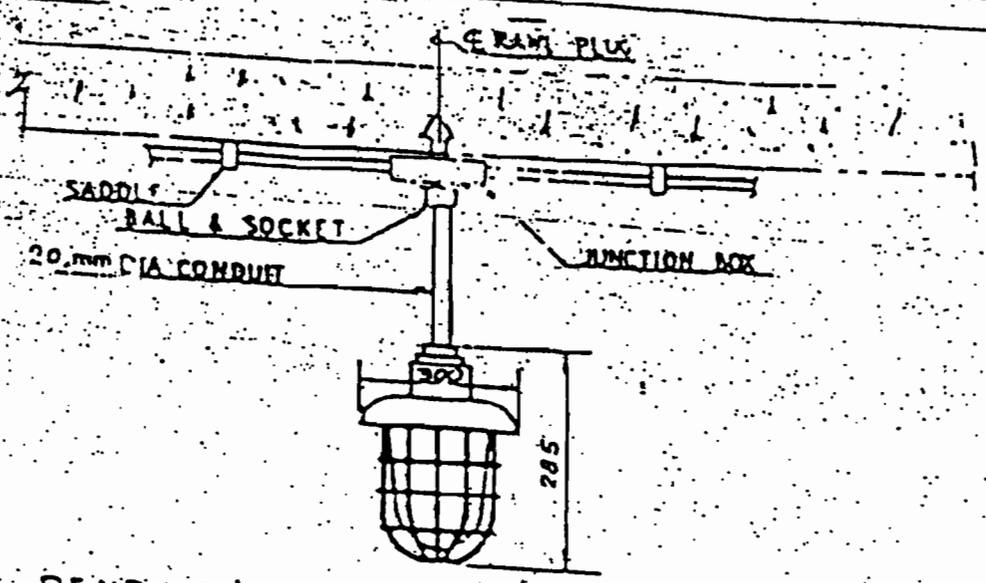



PENDANT/CEILING MOUNTING : TYPE-CA

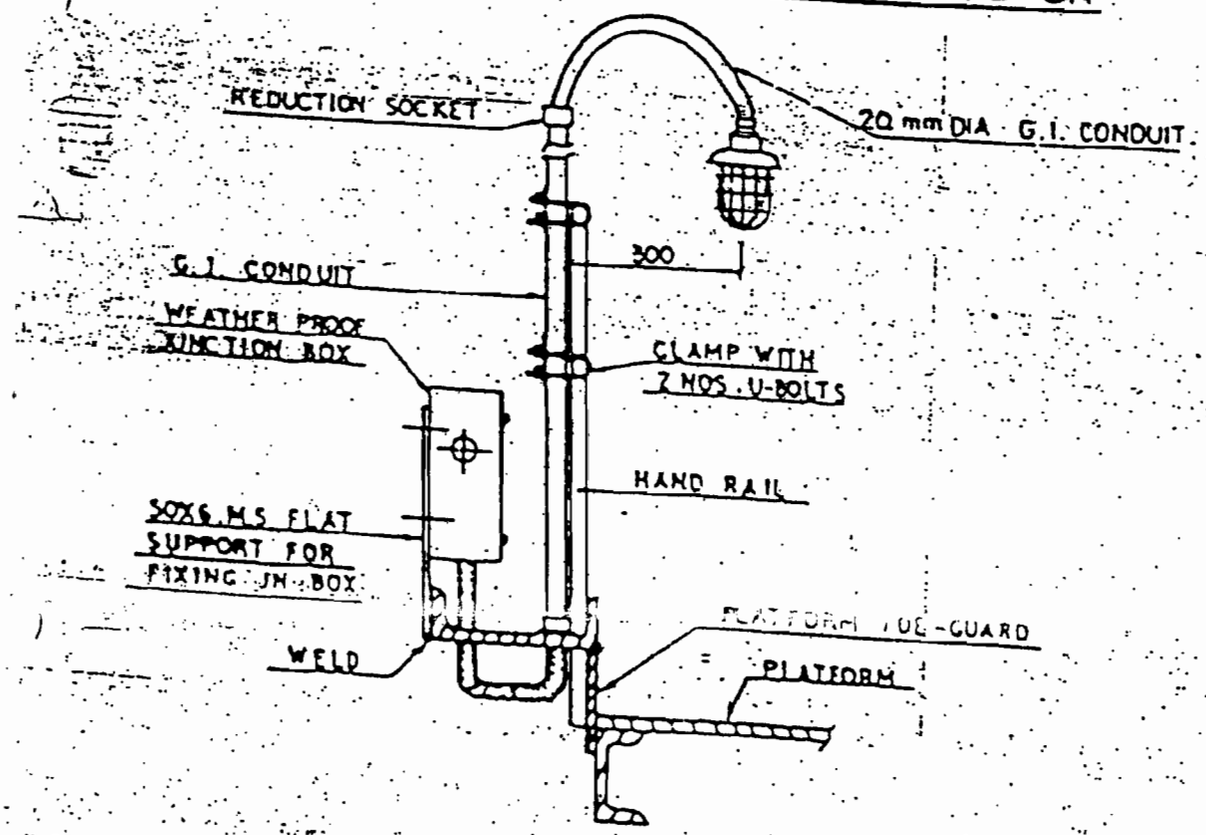



PLATFORM MOUNTING : TYPE-CB

| | |
|---|---|
| LIGHTING NOTES & DETAILS<br>FIXTURE MOUNTING ON DECK & STAIRS | DRG. No.<br>PE-DG-XXX558-0004 |
| | REV. No.<br>0 |
| | SHEET 8 OF 15 |

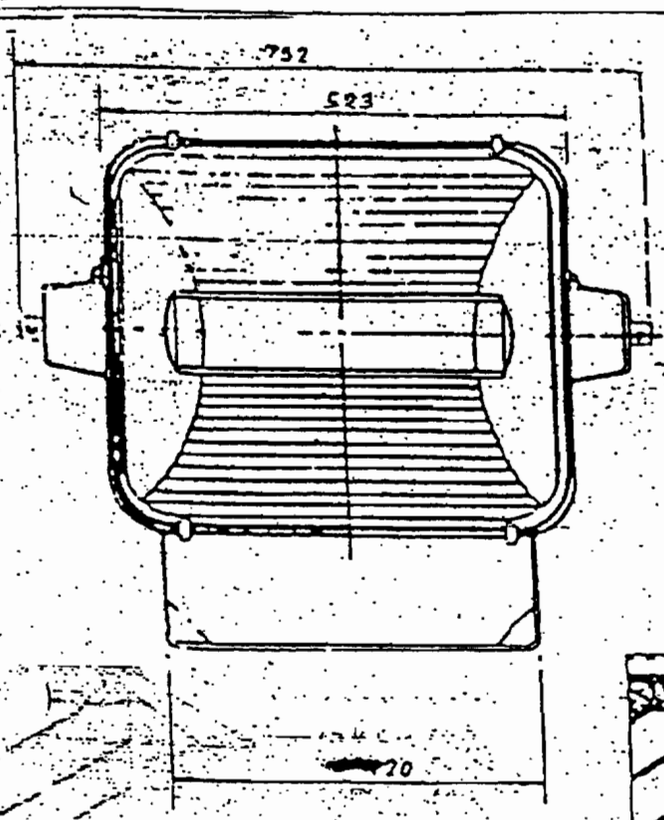



PENDANT/CEILING MOUNTING : TYPE-CA

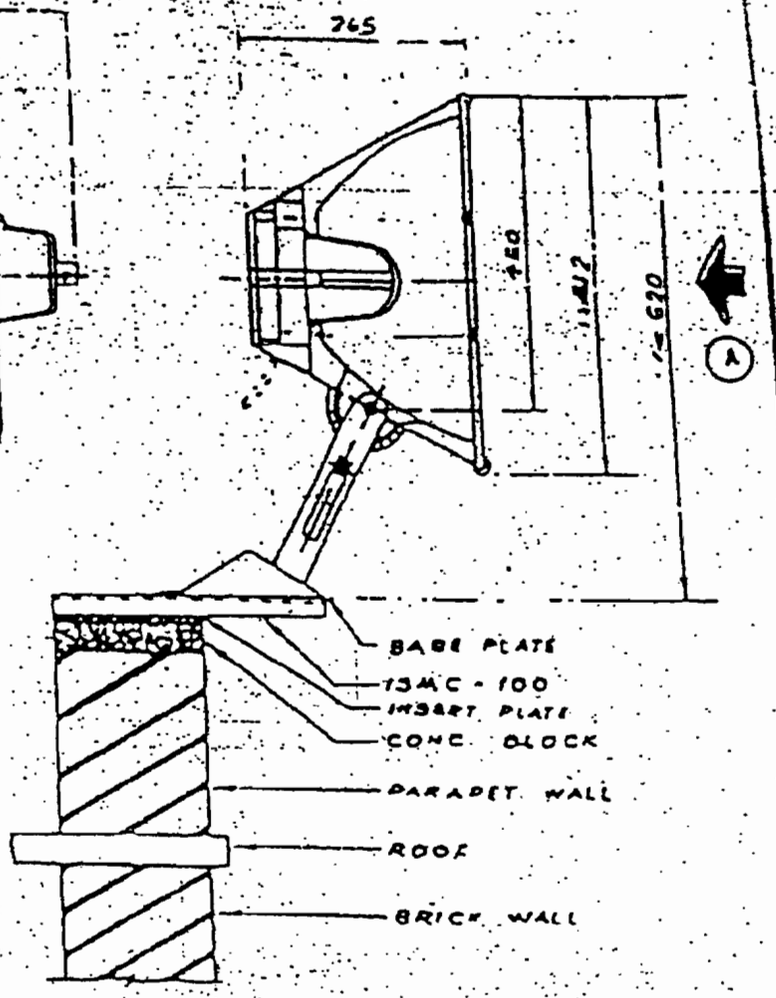


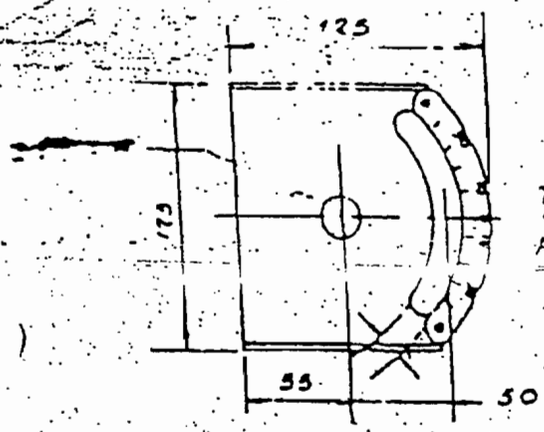

PLATFORM MOUNTING : TYPE-CB

| | |
|---|---|
| LIGHTING NOTES & DETAILS<br>FIXTURE MOUNTING ON DECK & STAIRS | DRG. No.<br>PE-DG-XXX-558-0004 |
| | REV. No.<br>0 |
| | SHEET 8 OF 15 |




VIEW A




BASE PLATE

TYPICAL MOUNTING ARRANGEMENT OF FLOOD LIGHT FIXTURE ON THE ROOF



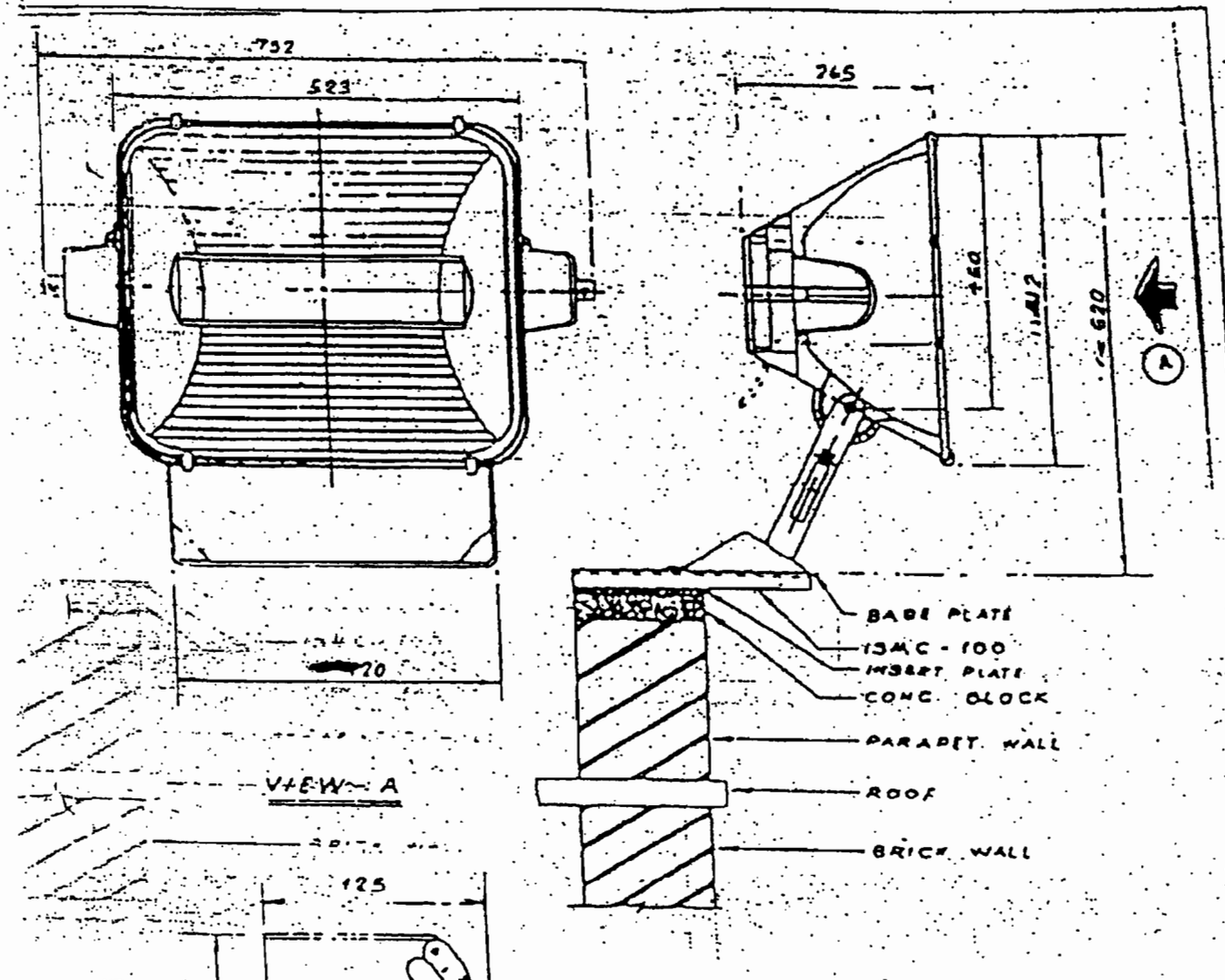
LIGHTING NOTES & DETAILS

MOUNTING OF FLOOD LIGHT FIXTURE

DRG. No.
PE-DG-XXX-558-0004

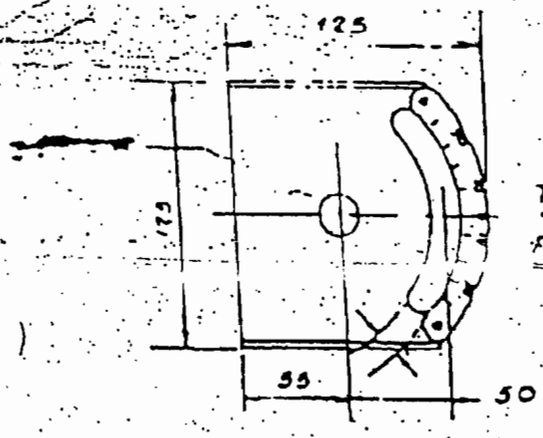
REV. No. 0

SHEET 9 OF 15




VIEW - A

TYPICAL MOUNTING ARRANGEMENT OF FLOOD LIGHT FIXTURE ON THE ROOF



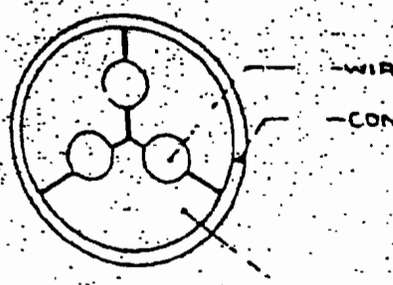

BASE PLATE

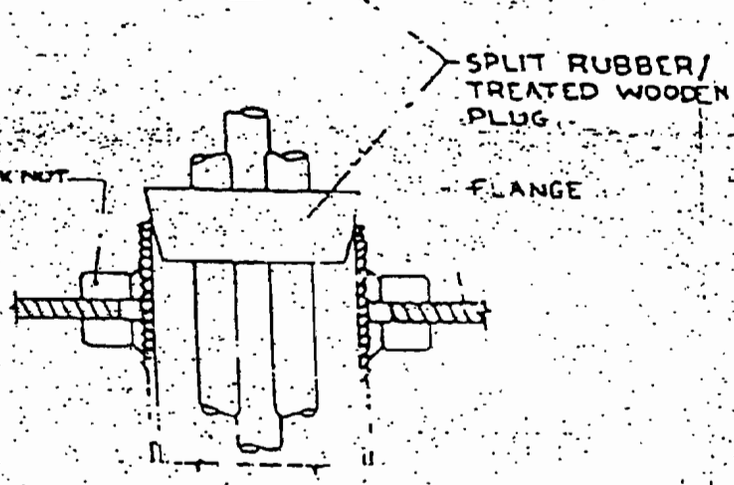
बीपीसीएल

# LIGHTING NOTES & DETAILS

MOUNTING OF FLOOD LIGHT FIXTURE

| | |
|---|---|
| DRG. No. | PE-DG-~~XXX~~-558-0004 |
| REV. No. | 0 |
| SHEET | 9 OF 15 |



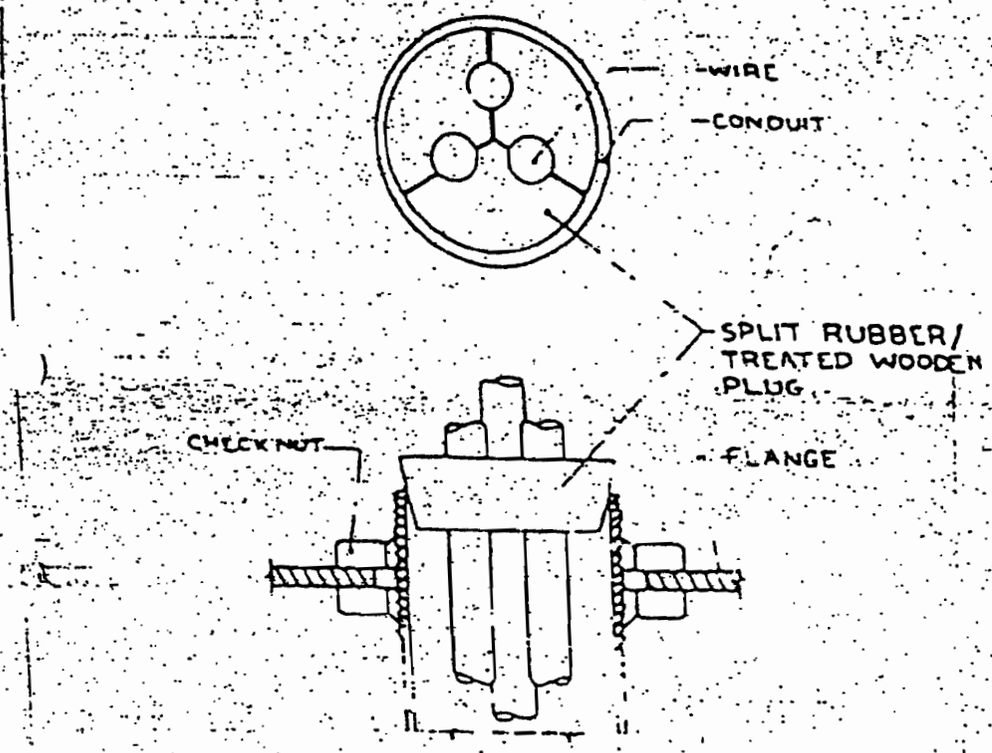

CLAMPING OF WIRES
IN CONDUIT VERTICAL RUN

LIGHTING NOTES & DETAILS

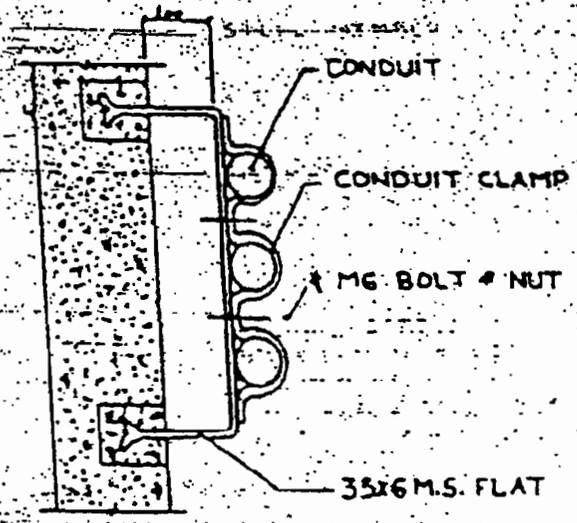
DRG. No.
PE-DG-~~XXX~~-558-0004

REV. No. 0

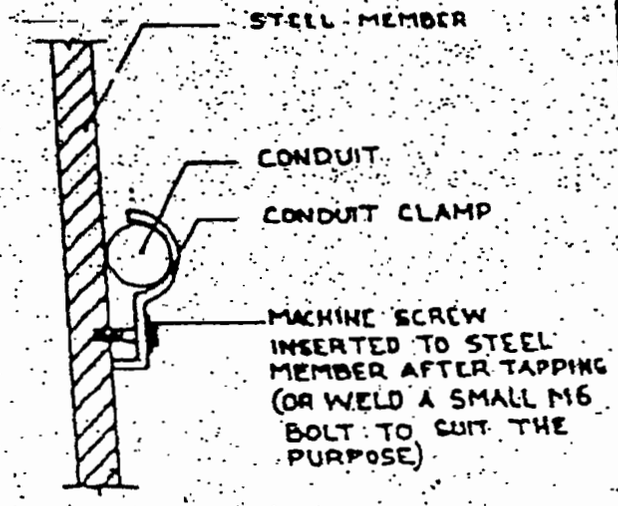
SHEET 10 OF 15



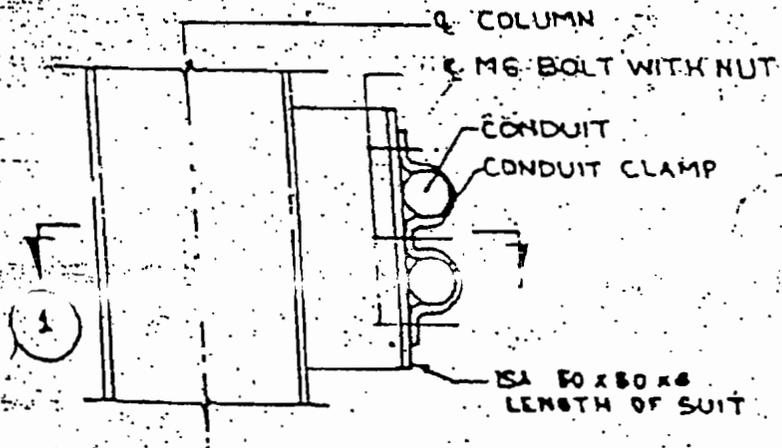

CLAMPING OF WIRES
IN CONDUIT VERTICAL RUN



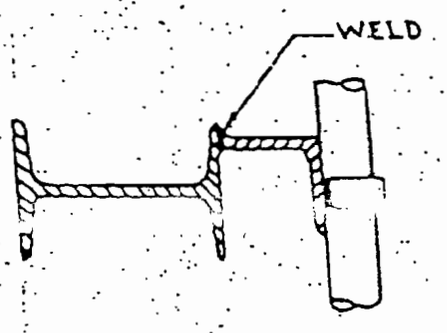

GROUP OF CONDUITS RUN ON CONCRETE SURFACE




SINGLE CONDUIT RUN ON STEEL MEMBER




ELEVATION




SECTION — (1)

GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT-A

LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-~~XXX~~-558-0004

REV. No. 11



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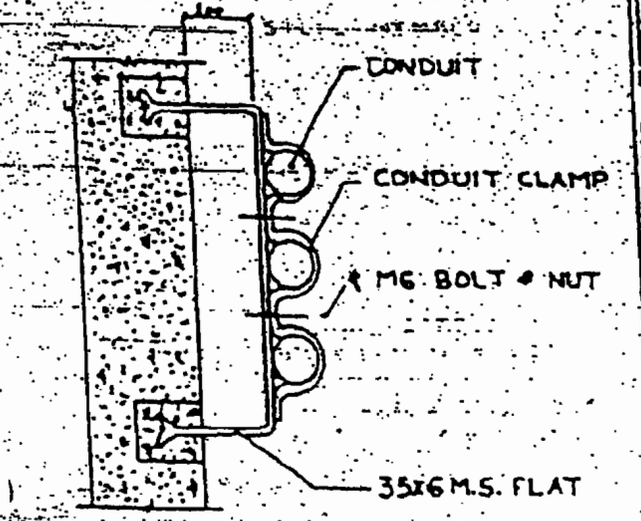
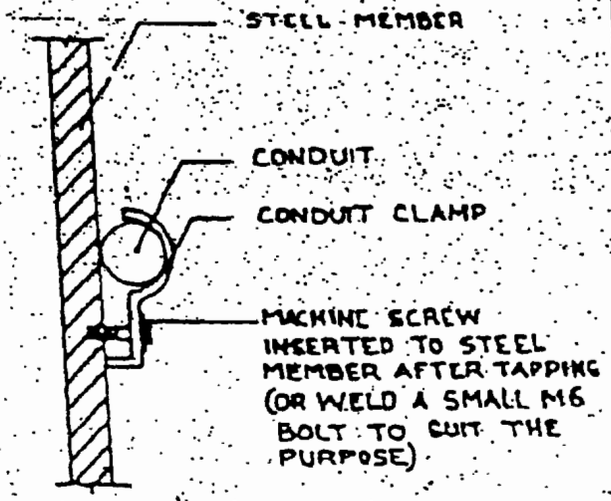
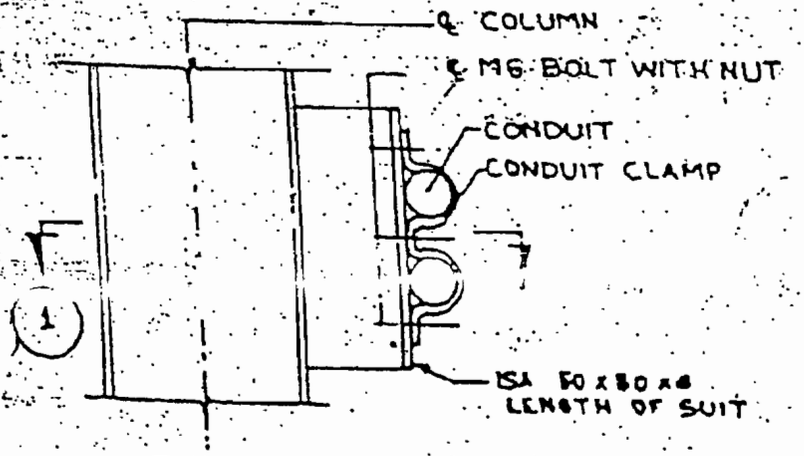


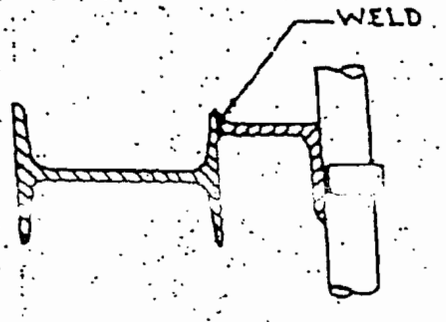

GROUP OF CONDUITS RUN ON CONCRETE SURFACE




SINGLE CONDUIT RUN ON STEEL MEMBER




ELEVATION



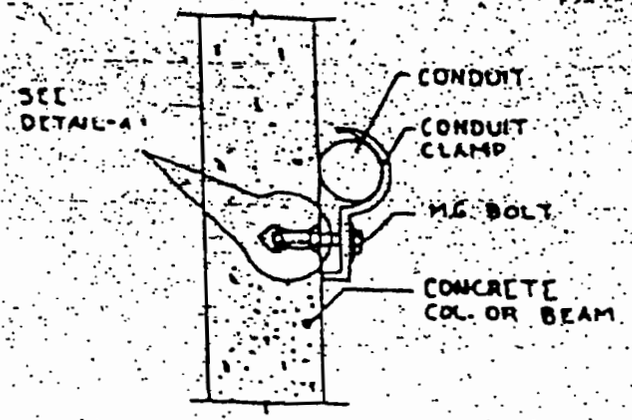

SECTION — (1)

GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT-A

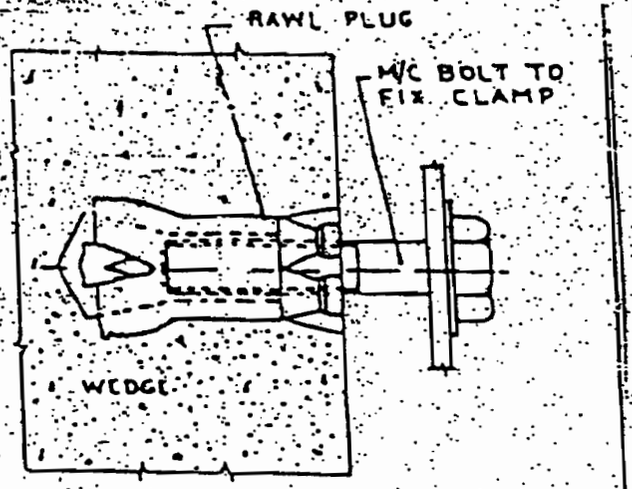
LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-~~XXX~~-558-0004

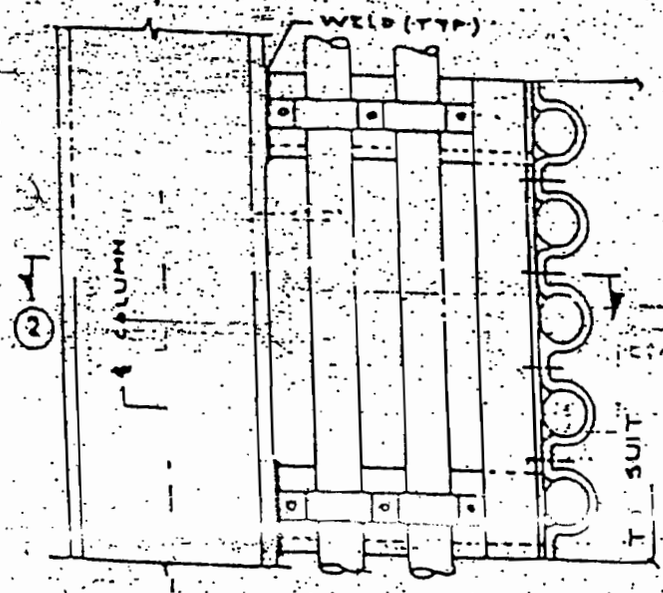
REV. No. 11 OF 15




SINGLE CONDUIT RUN ON CONCRETE SURFACE

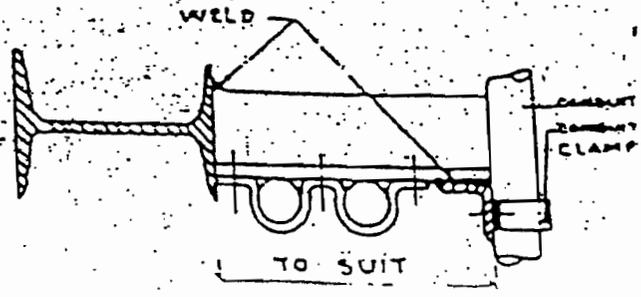



DETAIL - A




ELEVATION

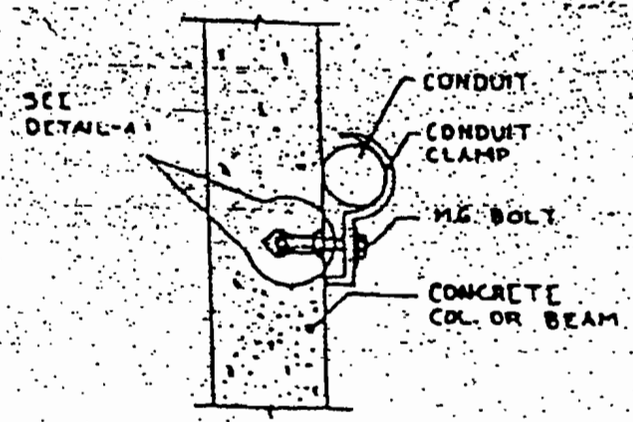
GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT-B



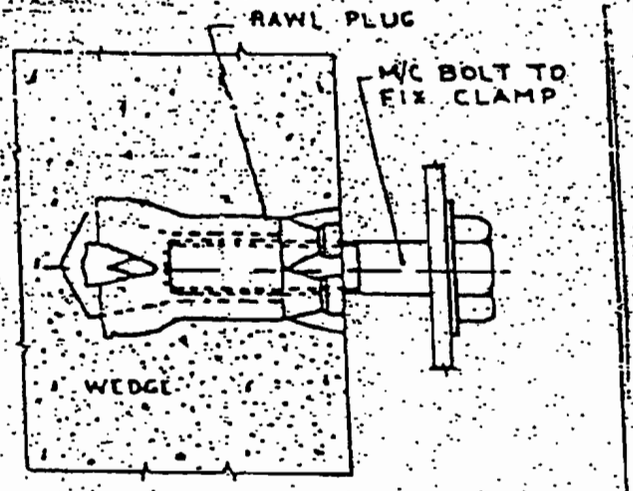

SECTION - (2)

LIGHTING NOTES & DETAILS

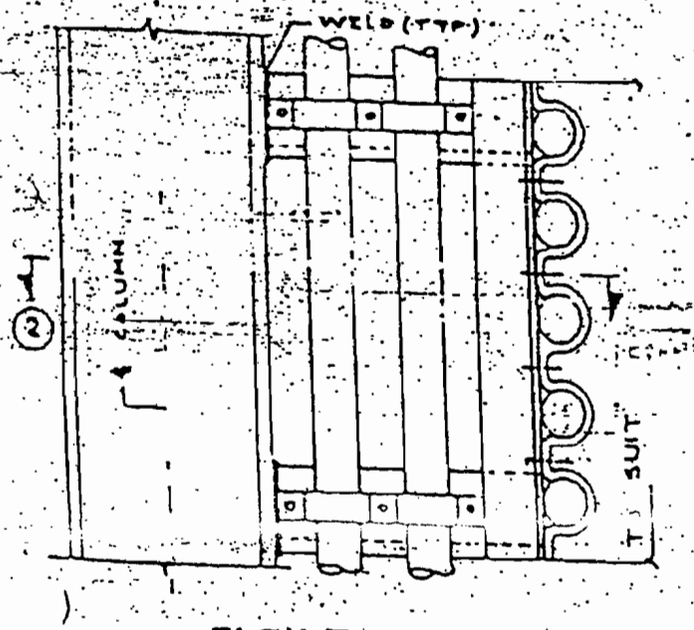
| | |
|---|---|
| DRG. No. | PE-DG-XXX-558-0004 |
| REV. No. | 0 |
| SHEET 12 | OF 15 |




SINGLE CONDUIT RUN ON CONCRETE SURFACE

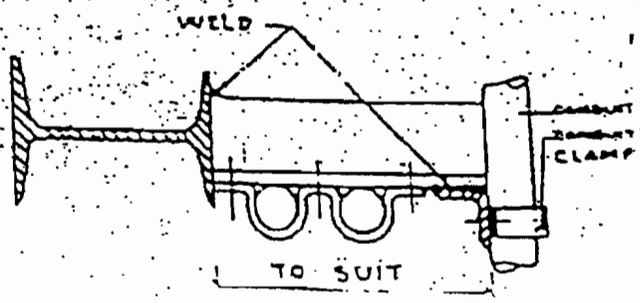



DETAIL - A




ELEVATION

GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT-B



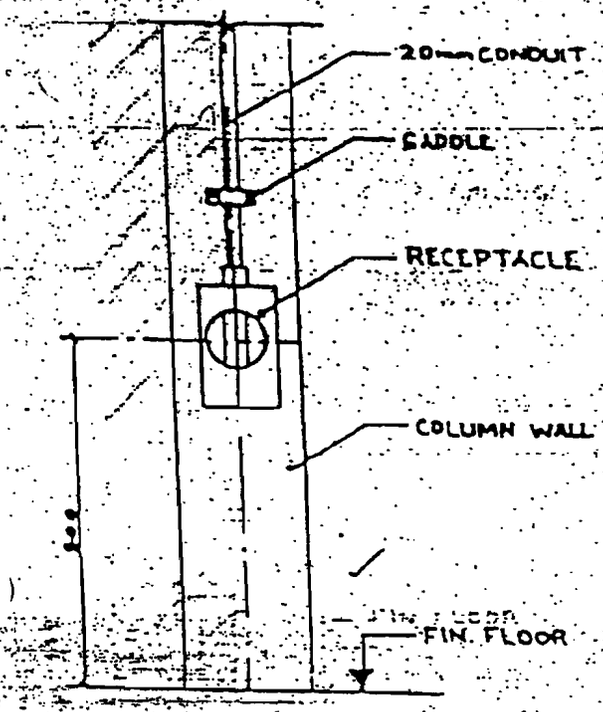

SECTION - (2)

LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-XXX-558-0004

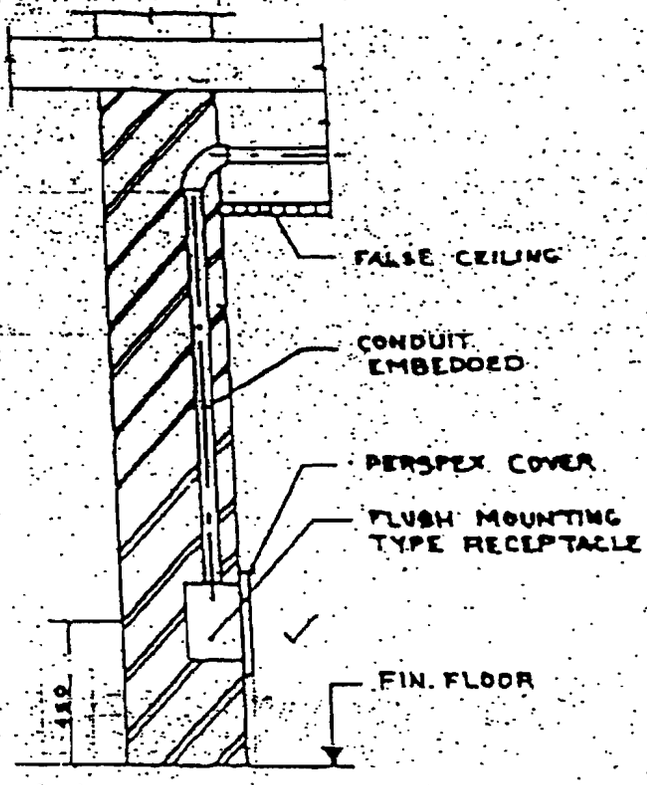
REV. No. 0

SHEET 12 OF 15



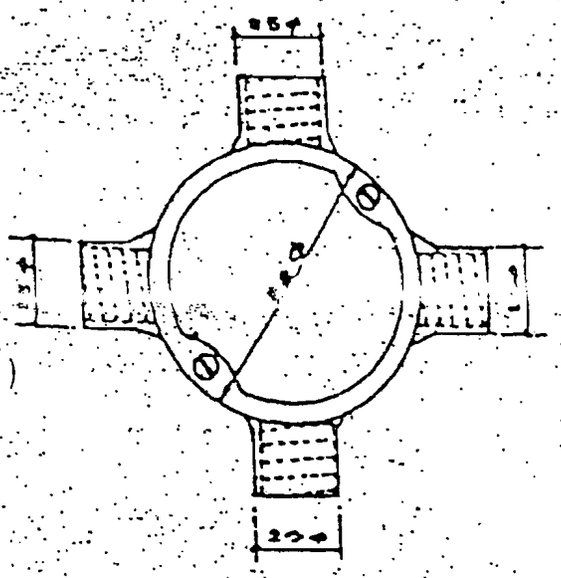

RECEPTACLE – TYPE 'R$_B$'

(STRUCTURE MOUNTING)




RECEPTACLE – TYPE 'R$_A$'

(WALL MOUNTING)



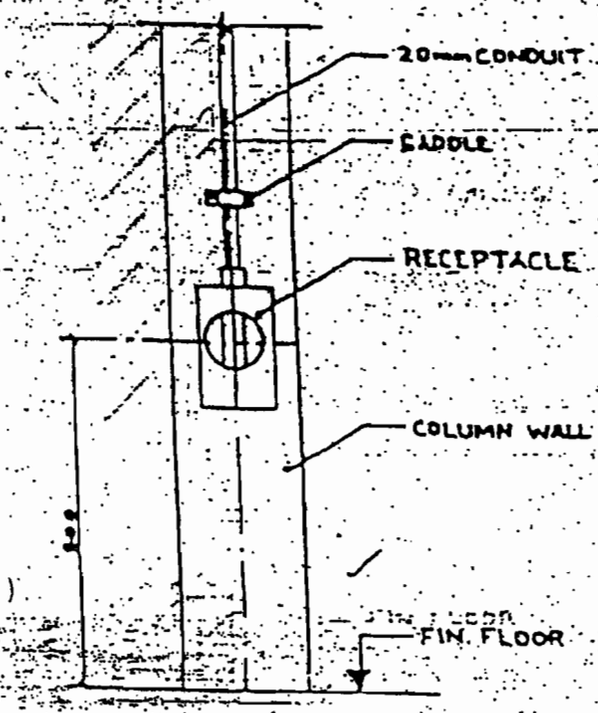
JUNCTION BOX ROUND (TYP.)

LIGHTING NOTES & DETAILS

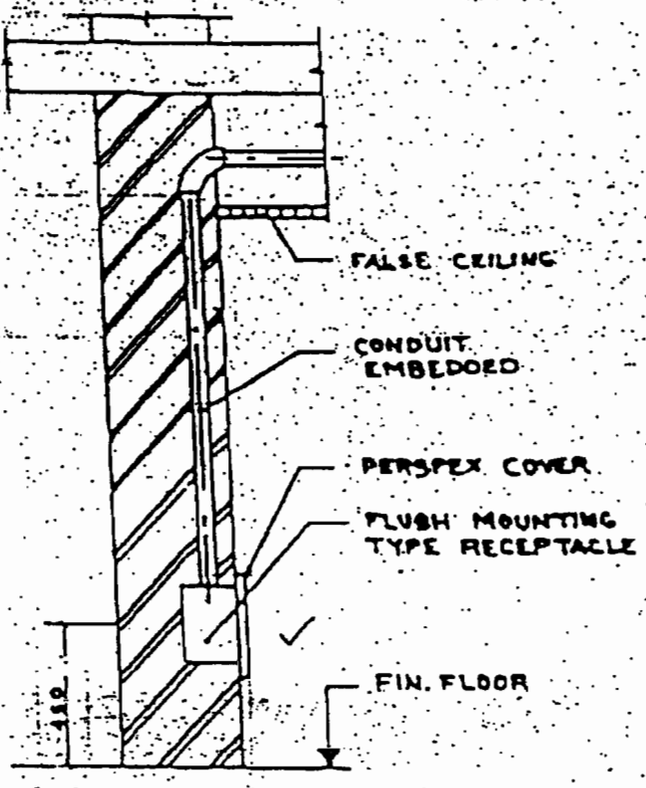
DRG. No.
PE-DG-~~XXX~~358-0004

REV. No. 0

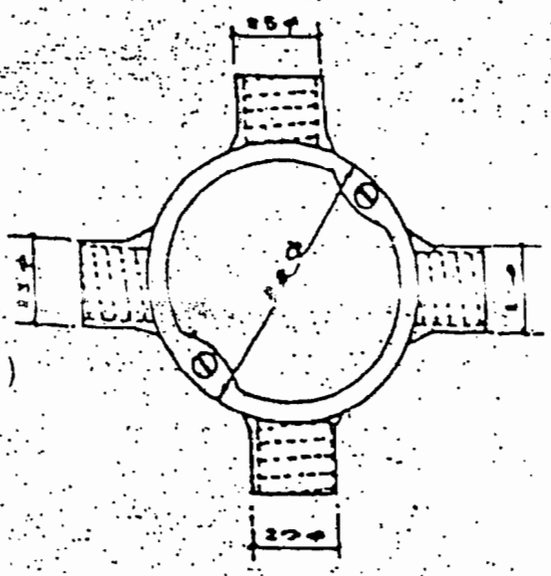
SHEET 13 OF 15




RECEPTACLE – TYPE 'R$_B$'
(STRUCTURE MOUNTING)

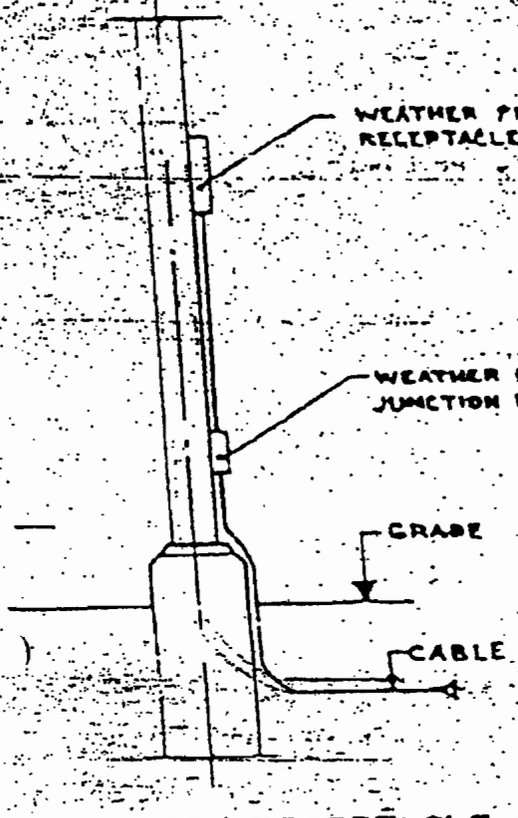



RECEPTACLE – TYPE 'R$_A$'
(WALL MOUNTING)

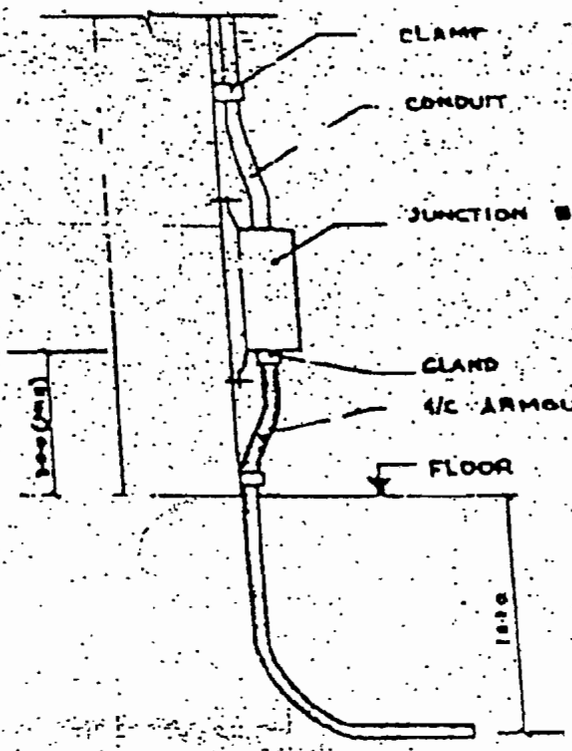


JUNCTION BOX ROUND (TYP.)

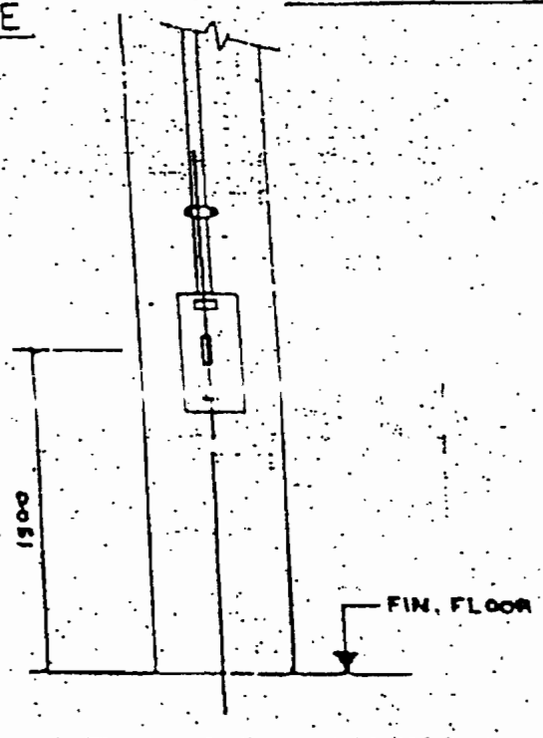
| | | |
|---|---|---|
| | LIGHTING NOTES & DETAILS | DRG. No. PE-DG-~~XXX~~358-0004 |
| | | REV. No. 0 |
| | | SHEET 13 OF 15 |




OUTDOOR RECEPTACLE

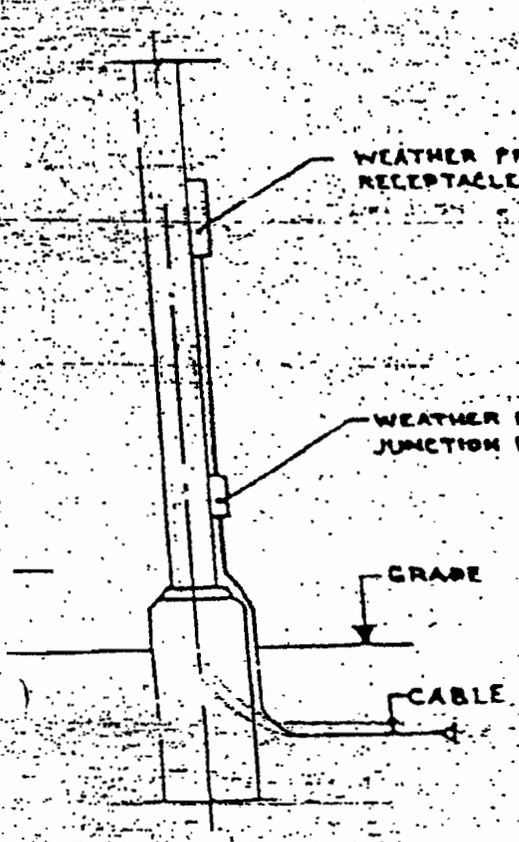



JUNCTION BOX MOUNTING (TYP.)

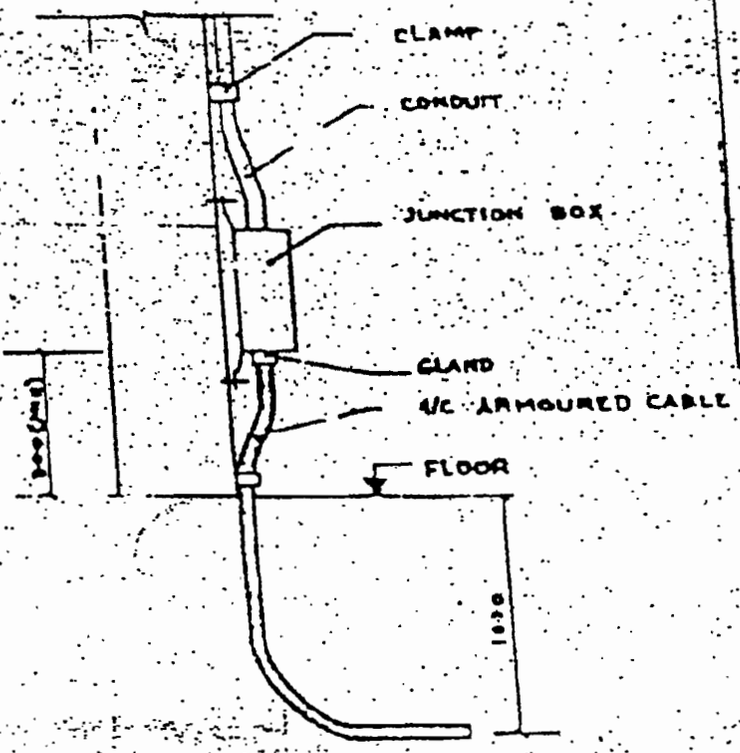



SWITCH ON COLUMN

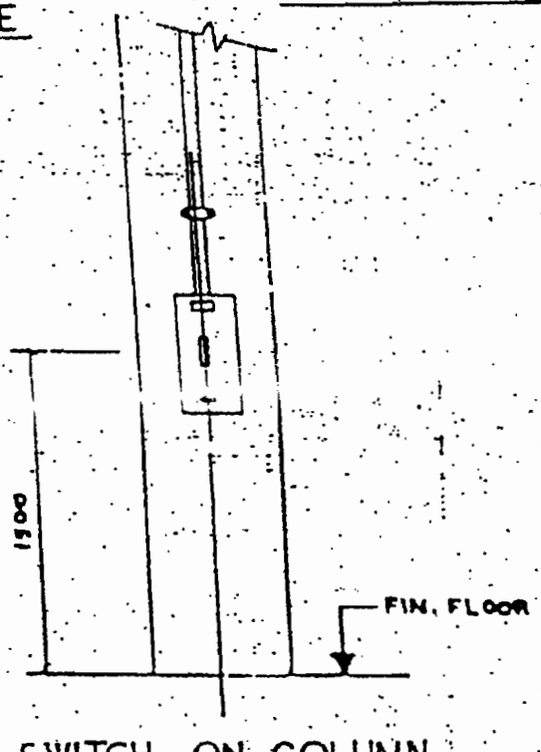
| | | |
|---|---|---|
| TATA PROJECTS LTD. | LIGHTING NOTES & DETAILS | DRG. No. PE-DG-~~XXX~~558-0004 |
| | | REV. No. 0 |
| | | SHEET 14 OF 15 |




OUTDOOR RECEPTACLE

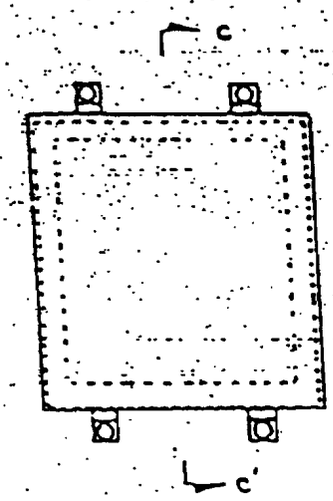



JUNCTION BOX
MOUNTING (TYP)

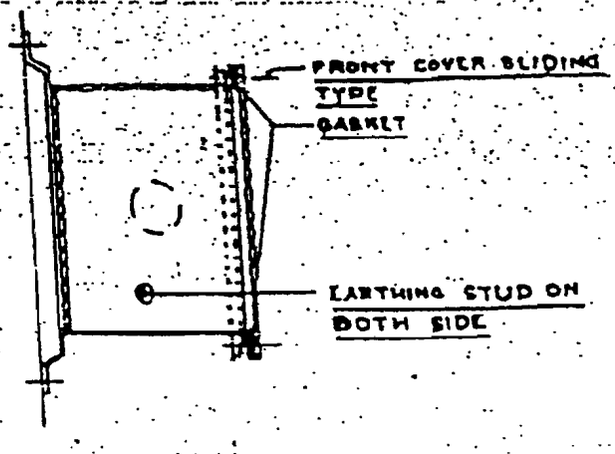



SWITCH ON COLUMN

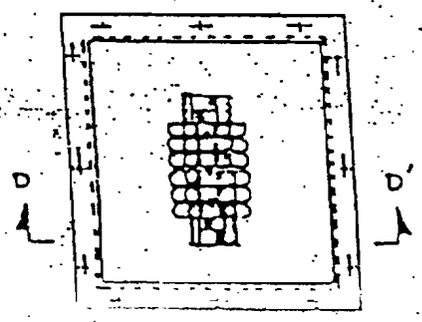
| | | |
|---|---|---|
| | LIGHTING NOTES & DETAILS | DRG. No. PE-DG-~~XXX~~558-0004 |
| | | REV. No. 0 |
| | | SHEET 14 OF 15 |



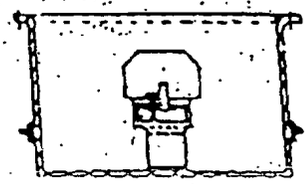

TYP. FIXING DETAIL OF JUNCTION BOX




SECTION: C-C'




JUNCTION BOX (TYP.) FRONT VIEW



SECTION: D-D'



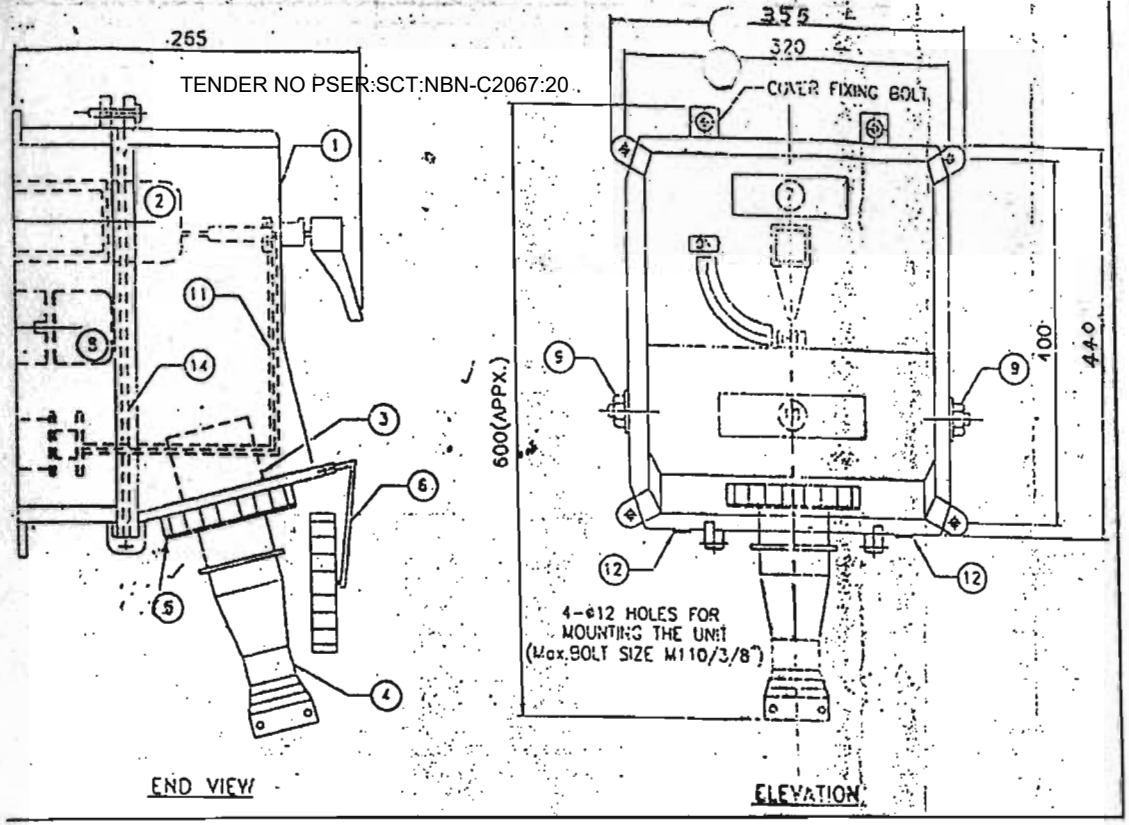
LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-~~XXX~~55B-0004

REV. No. 0

SHEET 15 OF 15

TENDER NO PSER:SCT:NBN-C2067:20

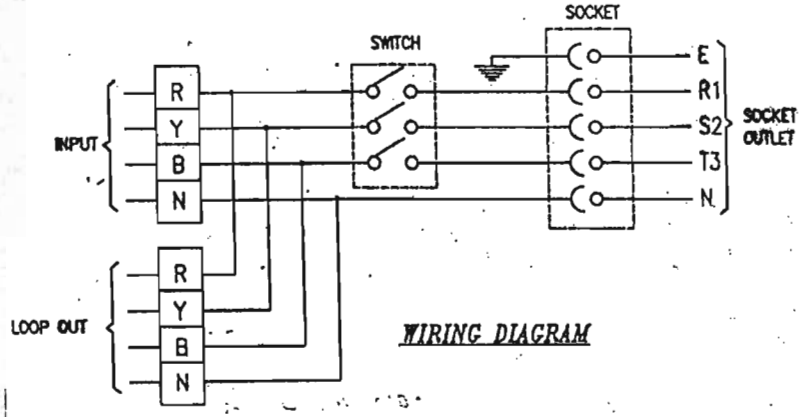



## SPECIFICATION

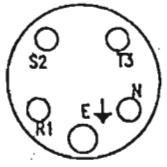
1] ALUMINIUM ALLOY HOUSING (MIN THICKNESS 3mm)
2] GE POWER CONTROL TP ON/OFF SWITCH DOUBLE BREAK TYPE SP02, AC23 CATEGORY CONFORMING TO IS-13947-3
3] BEST & CROMPTON MAKE-63A, 415V, 5 PIN TRIPLE POLE, NEUTRAL & EARTH SOCKET
4] BEST & CROMPTON MAKE-63A, 415V, 5 PIN TRIPLE POLE, NEUTRAL & EARTH PLUG
5] PLUG RING
6] SPRING LOADED COVER FOR SOCKET OUTLET
7] NAME PLATE
8] 4 WAY STUD TYPE TERMINAL BLOCK 2 Nos. FOR LOOP IN LOOP OUT, ARRAGEMENT TO TERMINATE 3.5x50 sq.mm STUD TYPE BEST & CROMPTON MAKE
9] ELECTROPLATED EARTHING TERMINAL 2 Nos. COMPLETE WITH 6mm BOLT,NUT & WASHER SUITABLE FOR 14 SWG. GI. EARTHING CONDUCTOR
10] CAUTION STACKER
11] MECHANICAL INTERLOCKING ARRANGEMENT
12] DETACHABLE GLAND PLATE O TAKE 2 Nos. GLAND SUITABLE FOR 3.5x70 sq.mM. CABLES.

## NOTES

1] ALL DIMENSION ARE IM MM UNLESS OTHERWISE SPECIFIED SUBJECT TO TOLERANCE ±5mm
2] EACH UNIT PROVIDED WITH INTERNAL WIRING SIZE 16 2.5 sq.mm. CABLE
3] THE ENCLOSURE IS PAINTED WITH SHADE GREY RAL 9002 – POWER COATING
4] THE UNIT ARE SUITABLE FOR OUTDOOR USE, IP-55 AS PER IS-13947
5] SWITCH CAN NOT BE MADE 'ON' UNLESS PLUG IS INSERTED
PLUG CAN NOT BE WITHDRAWN UNLESS SWITCH IS IN OFF POSITION
6] UNIT IS MANUFACTURE BY "BEST & CROMPTON"
7] SUITABLE CABLE GRIP SHALL BE PROVIDED




WIRING DIAGRAM




SHOWING TERMINAL POSITION

COLOUR CODED SLEVE WILL BE PROVIDED ON BOTH ENDS ON COPPER FLEIBLE
R PHASE – RED COLOUR
Y PHASE – YELLOW COLOUR
B PHASE – BLUE COLOUR
NEATRAL – BLACK COLOUR

1230-001-29PE-PVE-B-073

CHIMNEY LIGHTING SPECIFICATION

| REV | DATE | DESCRIPTION |
|---|---|---|
| 01 | | |
| 02 | | |

NATIONAL THERMAL POWER CORPORATION LTD.
RIHAND 2X500MW THERMAL POWER PROJECT STAGE-II

bajaj electricals limited MUMBAI
Engineering & Projects Division.

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR, PROJECT ENGINEERING MANAGEMENT
NEW DELHI

TENDER NO PSER:SCT:NBN-C2067:20

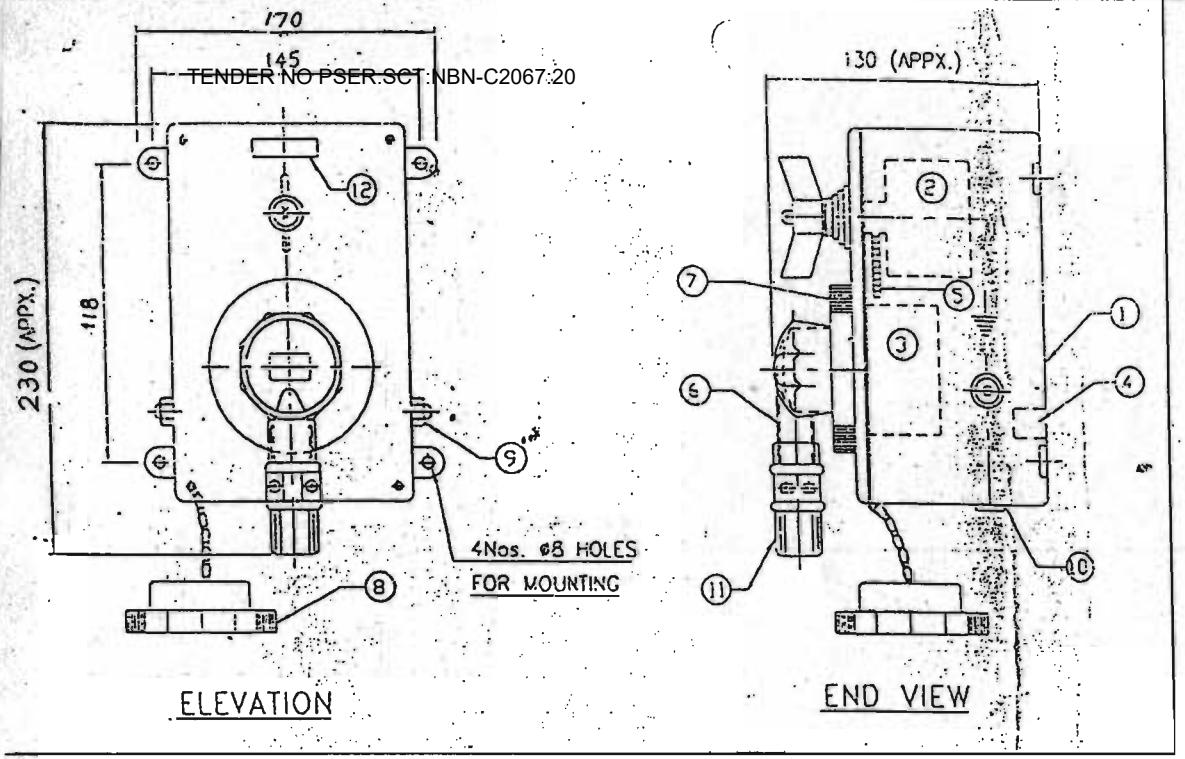
| DRN | CHKD | APPD | DATE | BHEL DWG. No |
|---|---|---|---|---|
| KBM | JS | AP | 30.06.03 | PE-V0-200-558-E073 |

TITLE GENERAL ARRANGEMENT DWG FOR 63 A FULLY INTERLOCKED SWITCHED PLUG 63 AMPS 415 VOLTS [TYPE RC]

DWG. NO. EPBU-03-PS005-04-073 REV. 0

SHT. 1 OF 1

TENDER NO PSER:SCT:NBN-C2067:20

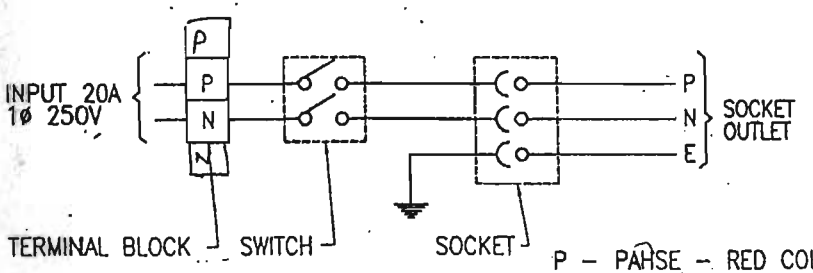



## SPECIFICATION

1] ALUMINIUM ALLOY ENCLOSURE 3mm THICK
2] 25A, 250V, DOUBLE POLE/ OFF ROTARY SWITCH AC 23 CATEGORY IS-4064 – RECOM MAKE
3] ALUMINIUM ALLOY METAL CLAD SOCKET UNIT "BEST & CROMPTON" MAKE
4] BAKELITE STUD TYPE 2 WAY TERMINAL BLOCK TO TERMINATE 2Cx4 sq.mm CABLE
5] MECHANICAL INTERLOCKING SYSTEM
6] DIE CAST ALUMINIUM ALLOY METAL CLAD PLUG AND SOCKET OF 20A, 240V, 3 PIN (P+N+E), 3rd PIN GROUNDED
7] THREADED PLUG LOCKING RING
8] SOCKET COVER WITH CHAIN FOR SOCKET OUTLET
9] EARTHING TERMINAL 2 Nos. – M6 SIZE
10] CABLE ENTRY 25mm DIA – 2Nos.
11] PVC CABLE GRIP
12] NAME PLATE

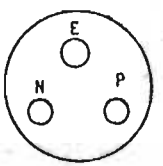
## NOTES

1] ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED SUBJECT TO TOLERANCE OF ±5mm
2] EACH UNIT PROVIDED WITH INTERNAL WIRING SIZE 4 sq.mm. COPPER CABLE
3] THE ENCLOSURE IS PAINTED WITH SHADE GREY RAL 9002 – POWDER COATING
4] THE UNIT ARE SUITABLE FOR OUTDOOR USE, IP-55 AS PER IS-13947
5] SWITCH CAN BE MADE 'ON' ONLY WHEN PLUG IS FULLY ENGAGED WITH SOCKET. PLUG CAN NOT BE WITH DRAWN WHEN SWITCH IS ON
6] 2 Nos. CABLE ENTRY AT BOTTOM




## WIRING DIAGRAM
(FOR SINGLE PHASE UNIT)

P – PHASE – RED COLOUR
N – NEUTRAL – BLACK COLOUR
E – GREEN COLOUR




*VIEW ON SOCKET PLUG REMOVED*

CHIMNEY LIGHTING SPECIFICATION.

| REV | DATE | DESCRIPTION |
|---|---|---|
| 01 | | |
| 02 | | |

1230-001-29PE-PVG-B-070

**NATIONAL THERMAL POWER CORPORATION LTD.**
RIHAND 2X500MW THERMAL POWER PROJECT STAGE-II

bajaj electricals limited MUMBAI
Engineering & Projects Division

TENDER NO PSER:SCT:NBN-C2067:20

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR: PROJECT ENGINEERING MANAGEMENT

| DRN | CHKD | APPD | DATE | BHEL DWG. No |
|---|---|---|---|---|
| VBU | IS | AP | 30.06.03 | PE-V0-200-558-E070 |

TITLE GENERAL ARRANGEMENT DWG FOR FULLY INTERLOCKED SWITCHED PLUG 20 AMPS, 250 VOLTS [TYPE RA]

DWG. NO. EPBU-03-PS005-04-070

REV 0

SHT. 1 OF 1

FORM No. PEM 6041–0

| | QUALITY PLAN | CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|---|---|
| | | BIDDER / VENDOR | QUALITY PLAN NUMBER PED–558–00–Q–001/01 | SPECIFICATION TITLE |
| | SHEET 1 OF 3 | SYSTEM | ITEM ILLUMINATION | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTIC CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| 1.0 | CABLES & WIRES | 1. SURFACE DEFECTS | MA | VISUAL | SAMPLE | BHEL SPEC., IS:694, IS:1554 | BHEL SPEC., IS:694, IS:1554 | INSPN. REPORT & TEST REPORT FROM MANUFACTURER | 3⁄2 | 2 | 1 | TO BE PROCURED FROM APPROVED SOURCE |
| | | 2.DIMENSIONS | MA | MEASUREMENT | SAMPLE | –DO– | –DO– | –DO– | 3⁄2 | 2 | 1 | |
| | | 3. TYPE TESTS | CR | ELEC. TESTS | ONE/TYPE & SIZE | BHEL SPEC., IS:694, IS:1554 | BHEL SPEC., IS:694, IS:1554 | TEST CERT. | 3 | 2 | 1 | |
| | | 4.ACCEP–TANCE TESTS | MA | –DO– | SAMPLING | –DO– | –DO– | –DO– | 3 | 2 | 1 | |
| | | 5. ROUTINE TESTS | MA | –DO– | 100% | –DO– | –DO– | –DO– | 3 | – | 2,1 | |
| | | 6. FRLS PROPS. | CR | FRLS TESTS | SAMPLES | BHEL SPEC. | BHEL SPEC. | –DO– | 3 | 2 | 1 | |
| 2.0 | JUNCTION BOXES, LIGHTING PANELS AND DISTRIBUTION BOARDS | | | | | | | | | | | |
| 2.1 | JUNCTION BOXES | 1.DIMENSIONS | MA | MEASUREMENTS | 100% | BHEL DRG. | BHEL DRG. | INSP. REPORT | 3 | – | 2 | COMPONENTS TO BE OF APPROVED MAKE. |
| | | 2.PAINT SHADE/ THICKNESS | MA | VISUAL / MEAS. | SAMPLE | BHEL SPEC./DRG. | BHELSPEC./DRG. | –DO– | 3 | – | 2 | |
| | | 3.HV / IR / HV | MA | ELECT. TESTS | 100% | 2KV AC FOR 1 MINUTE | 2KV AC FOR 1 MINUTE | –DO– | 3 | – | 2 | |
| | | 4.DEGREE OF PROTECTION | MA | TESTS | 1/SIZE | IS:2147 | IS:2147 | TEST CERT. | – | – | 2,1 | |
| | | 5.SPECIAL TESTS IF ANY, EXPLOSION PROOF ETC. | MA | –DO– | –DO– | IS:2148 | IS:2148 | –DO– | – | – | 2,1 | |
| 2.2 | LIGHTING PANELS AND LIGHTING DISTRIBUTION BOARDS | 1. DIMENSIONS | MA | MEASUREMENT | SAMPLE | BHEL DRG. | BHEL DRG. | INSPT. REPORT | 3 | 2,1 | – | COMPONENTS TO BE OF APPROVED MAKE. |

| BHEL | PARTICULARS | BIDDER / VENDOR |
|---|---|---|
| | NAME | |
| | SIGNATURE | |

FORM No. PEM 6041–0

| | QUALITY PLAN | CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|---|---|
| | | BIDDER / VENDOR | QUALITY PLAN NUMBER PED–558–00–Q–001/01 | SPECIFICATION TITLE |
| | SHEET 2 OF 3 | SYSTEM | ITEM ILLUMINATION | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTIC CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 10 | 11 |
| | | 2. PAINT SHADE/ THICKNESS | MA | VISUAL/ MEASUREMENT | –DO– | BHEL SPEC./DRG. | BHEL SPEC./DRG. | INSPT. REPORT | 3 | 2,1 | – | |
| | | 3.DEGREE OF PROTECTION (INCLUDING EXPLOSION PROOF IF ANY) | MA | TESTS | 1/SIZE | BHEL SPEC./ RELEVANT IS | BHEL SPEC./ RELEVANT IS | TEST CERTF. | – | – | 2,1 | |
| | | 4.PERFORMANCE TESTS | MA | ELEC. | 100% | BHEL SPEC. | BHEL SPEC. | INSPT. REPORT | 3 | 2,1 | – | BHEL SHALL WITNESS ON RANDOM ONE SAMPLE, THOUGH EACH ITEM SHALL BE CHECKED BY THE MANUFACTURER. |
| | | 5.HV/IR/HV | MA | ELEC. | 100% | 2.5 KV AC FOR 1 MINUTE | 2.5 KV AC FOR 1 MINUTE | –DO– | 3 | 2,1 | – | –DO– |
| | | 6. TEMP. RISE TEST (FOR COM–PLETE ASSEMBL–ED LDB) | MA | ELEC. | 1/RATING | BHEL SPEC. | BHEL SPEC. | –DO– | 3 | 2 | 1 | |
| 3.0 | TUNGSTEN FILAMENT LAMPS, TUBULAR FLUORESCENT LAMPS, H.P. MERCURY VAPOUR LAMPS,SODIUM VAPOUR LAMPS,BALLASTS, LUMINAIRES | 1. – ACCEPTANCE TESTS | MA | TESTS | SAMPLE | BHEL SPEC./ RELEVANT IS | BHEL SPEC./ RELEVANT IS | TEST CERTF. | 3,2 | – | 1 | |

| BHEL | PARTICULARS | BIDDER / VENDOR |
|---|---|---|
| | NAME | |
| | SIGNATURE | |

FORM No. PEM 6041–0

| | QUALITY PLAN | CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|---|---|
| | | BIDDER / VENDOR | QUALITY PLAN NUMBER PED–558–00–Q–001/01 | SPECIFICATION TITLE |
| | SHEET OF 3 | SYSTEM | ITEM ILLUMINATION | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTIC CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| 4.0 | CONDUITS | 1. MATERIAL | MA | VISUAL, MECH. AND CHEMICAL | AS PER SPEC./ IS : 9537 | IS:9537 | IS:9537 | INSPT. REPORT | 3 | 2 | 1 | |
| | | 2. DIMENSIONS | MA | MEASUREMENT | AS PER SPEC./ IS : 9537 | IS:9537 | IS:9537 | –DO– | 3 | 2 | 1 | |
| | | 3. OTHER TESTS | MA | TESTS | AS PER SPEC./ IS:9537, | AS PER SPEC./ IS:9537, | IS:9537, | –DO– | 3 | 2 | 1 | |
| 5.0 | ELECTRIC POLES | | | | | | | | | | | |
| 5.1 | MATERIAL | 1. CHEMICAL COMP. | MA | CHEM. ANALYSIS | SAMPLE | IS:2713, IS:228 & IS:1894 | IS:2713 IS:228 & IS:1894 | –DO– | 3/2 | – | 2,1 | |
| | | 2. PHYSICAL PROP. | MA | PHYS. TESTS | –DO– | –DO– | –DO– | –DO– | 3/2 | – | 2,1 | |
| 5.2 | FINAL INSPECTION | 1. WORK–MANSHIP & FINISH | MA | VISUAL & MEAS. | SAMPLES | BHEL DRG./IS:2713 | BHEL DRG./IS:2713 | –DO– | 3/2 | 2,1 | – | |
| | | 2. DIMENSIONS | MA | –DO– | –DO– | –DO– | –DO– | –DO– | 3/2 | 2,1 | – | |
| | | 3. WEIGHT | MA | –DO– | –DO– | –DO– | –DO– | –DO– | 3/2 | 2,1 | – | |
| | | 4. TESTS AS PER IS:2713 | MA | –DO– | –DO– | IS:2713 | IS:2713 | –DO– | 3/2 | 2,1 | – | |

NOTE : IN CASE TYPE TEST CERTIFICATE FOR DEGREE OFPROTECTION /EXPLOSION PROOFNESS FROM INDEPENDENT LAB. IS NOT AVAILABLE, THE ITEM SHALL BE TESTED AT AN INDEPENDENT LAB.

| BHEL | PARTICULARS | BIDDER / VENDOR |
|---|---|---|
| | NAME | |
| | SIGNATURE | |

| | TITLE: | SPECIFICATION NO. PE-TS-Q11-600-C051 |
|---|---|---|
| BHEL | SPECIFIC TECHNICAL REQUIREMENT | VOLUME - IIB |
| | | SECTION "C" \| Sub Sec-II |
| | | REV. 00 DATE: 22 – 10 - 2003 |
| | | SHEET 1 of 3 |

1.00.00 **CODES AND STANDARDS** IS:1554, IS:7098, IEC:502, IS:6380, IS:9968

2.00.00 **TYPE** All cable shall be Flame retardent low smoke type

3.00.00 **RATING** As per requirement specified in General Electrical Requirements.

4.00.00 **OPERATIONAL REQUIREMENTS**

All cables shall be suitable for high ambient, high humid tropical Indian climatic conditions. All cables shall be designed to withstand the mechanical, electrical and thermal stresses under the foreseen steady state and transient/fault conditions, and shall be suitable for the proposed method of installation.

5.00.00 **DESIGN AND CONSTRUCTIONAL FEATURES**

5.01.00 Parameters of the cables are as follows :

| Particulars | Power cables | | Control cables | Trailing cables |
|---|---|---|---|---|
| | XLPE | PVC | | |
| a) Conductor | | | | |
| i) Material | Stranded Aluminium | | Stranded plain annealed copper | Tinned copper of class 5 of IS:8130 |
| ii) Size | As required, but Min. 6 sq.mm size. | | As required, but min. 1.5 sq.mm. size. | As required, but min. 1.5 sq.mm. size. |
| iii) Shape | Circular/ sector shaped. Circular only for HT cables | Circular/ sector shaped | | |
| b) Main Insulation | | | | |
| i) Material | XLPE | PVC | PVC | Heat resistant elastomeric compound based on Ethylene Propyline Rubber (EPR) |

| Particulars | | Power cables | | Control cables | Trailing cables |
|---|---|---|---|---|---|
| | | XLPE | PVC | | |
| ii) | Continuous withstand temperature (deg.C) | 90 | 70 / 70 | 90 | |
| iii) | Short circuit withstand temperature (deg.C) | 250 | 160 / 160 | 250 | |
| iv) | Colour identi-fication | As per relevant codes and standards | | | |
| c) | Inner Sheath | All armoured and multicore unarmoured cables have distinct extruded inner sheath | | | |
| | i) Material | PVC | PVC | PVC | Heat resistant elastomeric compound. |
| | ii) Colour | Black | Black | Black | Black |
| d) | Armour, wherever provided | | | | |
| | i) Material | Aluminium wire for single core cable and GS wire/flat for multi-core cables as per relevant IS. Minimum Coverage of 90% | | GS wire/flat as per relevant IS. Min. coverage of 90%. | Nylon cord reinforcemenet |
| | ii) Breaking load of joint | 95% of normal armour | | 95% of normal armour | |
| e) | Outer sheath | All power & control cable shall have extruded outer sheath. | | | |
| | i) Material (Polyethe-lene based halogen free material not acceptable) | PVC | PVC | PVC | Heat resistant, oil resistant & flame retardant heavy duty elast-tomeric compound |

| Particulars | | Power cables XLPE | Power cables PVC | Control cables | Trailing cables |
|---|---|---|---|---|---|
| ii) | Colour | Black | Black | Grey | Black |
| iii) | Marking | - Cable size & voltage grade (by embossing)<br>- Word "FRLS" @ 5m (by embossing)<br>- Sequential marking @1m | | Same as for Power Cables | Same as for Power Cables |

| | | | |
|---|---|---|---|
| f) | FRLS properties on outer sheath | Oxygen Index :<br>Acid gas generation:<br>Smoke density rating: | Min. 29 (As per ASTMD 2863)<br>Max. 20% (As per IEC754-I)<br>60% (As per ASTMD 2843) |
| g) | Flamability test on all types of cables | As per Swedish chimney test F3 as per SEN 4241475<br>As per IEC 332 Part-3 (Category B) | |

5.01.02 **HT cables**

For HT cables conductor screen and insulation screen shall be of extruded semi-conducting compound and shall be applied alongwith XLPE insulation in a single operation by triple extrusion process. Method of curing for 11kV/6.6kV cables shall be "Dry curing/gas curing/steam curing" whereas for 33KV cables it shall be "Dry/Gas curing". 11kV/6.6kV cables shall be provided with copper metallic screen suitable for carrying allowable earth fault current for 2 secs. All other voltage grade HT cables shall be provided with copper metallic screen suitable for carrying earth fault current as per E0. For single core armoured cables, the armouring shall constitute the metallic part of screening.

5.01.03 LT Cables of size 150 sq.mm. and above shall be with XLPE insulation.

5.01.04 **Core identification**

For cables having more than five (5) cores, each core shall be identified by number marking. However, for cables upto five (5) cores, the same shall be by colour as per IS.

5.01.05 **Armouring**

Cables buried direct in ground and cables in switchyard shall be armoured.

| Clause No. | POWER AND CONTROL CABLES | | |
|---|---|---|---|
| | | ..... (Bidder's Name) | |
| | **POWER AND CONTROL CABLES** (Use separate sheet for each type and size of cables) | | |
| 1.00.00 | Make | ..... | ..... |
| 1.02.00 | Country of Manufacturer | ..... | ..... |
| 1.03.00 | Type & designation | ..... | ..... |
| 1.04.00 | Applicable standard | ..... | ..... |
| 1.05.00 | Cable size & no. of cores | ..... | ..... |
| 1.06.00 | Rated voltage | ..... | ..... |
| 1.07.00 | Catalogue attached as Annexure No. | ..... | ..... |
| 1.08.00 | Continuous current rating for max. conductor temperature | ..... | ..... |
| | a) When laid in air at an ambient temperature of 50 deg. C | ..... | ..... |
| | b) When buried in soil having thermal resistivity of 150 deg.C cm/n at a depth of 1000 mm at ground ambient temperature of 40 deg. C | ..... | ..... |
| 1.09.00 | Short circuit withstand capacity and duration for | ..... | ..... |
| | a) Conductor | ..... | ..... |
| | b) Screen | ..... | ..... |
| | c) Armour | ..... | ..... |
| 1.10.00 | Conductor | ..... | ..... |
| | a) Material | ..... | ..... |
| | b) Nominal cross section area in sq. mm | ..... | ..... |

| Clause No. | POWER AND CONTROL CABLES | | |
|---|---|---|---|
| | | ..... (Bidder's Name) | |
| | c) Shape of conductor | ..... | ..... |
| | d) DC resistance at 20°C | ..... | ..... |
| 1.11.00 | Insulation | | |
| | a) Material | ..... | ..... |
| | b) Nominal thickness (in mm) | ..... | ..... |
| | c) Type of curing (for XLPE) | ..... | ..... |
| 1.12.00 | Metallic screen (wherever applicable) | | |
| | a) Material | ..... | ..... |
| | b) Type | ..... | ..... |
| | c) Rating KA, Sec | | |
| 1.13.00 | Material & Type of Inner sheath | ..... | ..... |
| 1.14.00 | Armour material & shape | ..... | ..... |
| 1.15.00 | Outer sheath material & type | ..... | ..... |
| 1.16.00 | Over all dia of cable (in mm) | ..... | ..... |
| 1.17.00 | Guaranteed value of minimum oxygen index of outer sheath | ..... | ..... |
| 1.18.00 | Maximum acid-gas generation by weight (%) of outer sheath | ..... | ..... |
| 1.19.00 | Smoke Density rating of outer sheath | ..... | ..... |

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44

# QUALITY PLAN

| CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|
| BIDDER / VENDOR | QUALITY PLAN NUMBER PED–507–00–Q–002 / 02 | SPECIFICATION TITLE |
| SHEET 1 OF 6 | SYSTEM | ITEM PVC POWER & CONTROL CABLE | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| 1.0 | RAW MATERIAL | | | | | | | | | | | |
| 1.1 | PVC COMPOUND (FOR INSULATION- AND SHEATH) | 1. PHYSICAL PRO- PERTIES | MA | PHYS TESTS | SAM- PLE | IS:5831/ BHEL SPEC- IFICATION | IS:5831/ BHEL SPEC IFICATION | LOG BOOK /TEST CERT | 3/2 | - | 2 | |
| | | 2. ELEC. PROPER- TIES | MA | ELEC TEST | -DO- | -DO- | -DO- | -DO- | 3/2 | - | 2 | |
| | | 3.MAKE & TYPE | MA | VISUAL | 100 % | PLANT STD. | PLANT STD. | DO | 2 | - | - | |
| 1.2 | GALVANIZED STEEL WIRE / STRIP | 1. PHY. AND ELEC PROPERTIES | MA | PHY. ELEC.TESTS | SAM-* PLE | IS:3975, BHEL SPEC | IS:3975 BHEL SPEC | -DO- | 3/2 | - | 2 | * SAMPLE FROM EACH BATCH / LOT |
| | | 2. DIMENSION | MA | MEASUREMENT | -DO- | -DO- | -DO- | -DO- | 3/2 | - | 2 | |
| | | 3. GALVANIZAT- ION QUALITY | MA | GALV. TESTS | -DO- | -DO- | -DO- | -DO- | 3/2 | - | 2 | |
| 1.3 | COPPER / ALUMINIUM RODS / WIRES | 1. PHYSICAL PROERTIES. | MA | PHY.TESTS | -DO- | IS:613 IS:5484 IS:8130 AND BHEL SPEC. | IS:613 IS:5484 IS:8130 AND BHEL SPEC. | -DO- | 3/2 | - | 2 | |
| | | 2.CHEM COMPOS- ITION & PURITY | MA | CHEM ANALYSIS | -DO- | -DO- | -DO- | -DO- | 3/2 | - | 2 | |
| | | 3. ELECTRICAL PROPERTIES | MA | ELECTRICAL TESTS | -DO- | -DO- | -DO- | -DO- | 3/2 | - | 2 | |
| | | 4. DIMENSION | MA | MEASURMENT | -DO- | -DO- | -DO- | -DO- | 3/2 | - | 2 | |

| BHEL | PARTICULARS | BIDDER / VENDOR | |
|---|---|---|---|
| | NAME | | |
| | SIGNATURE | | |
| TENDER NO PSER:SCT:NBN-C2067:20 | DATE | | BIDDER'S / VENDOR'S COMPANY SEAL |

FORM No. PEM 6041–0

| | QUALITY PLAN | CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|---|---|
| | | BIDDER / VENDOR | QUALITY PLAN NUMBER PED–507–00–Q–002 / 02 | SPECIFICATION TITLE |
| | SHEET 2 OF 6 | SYSTEM | ITEM PVC POWER & CONTROL CABLE | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| 2.0 | IN PROCESS | | | | | | | | | | | |
| 2.1 | WIRE DRAWING, TINNING AND ANNEALING | 1. PHYSICAL, ELECT. FINISH & DIMEN. | CR | PHY. & ELECT-TESTS VISUAL, MEAS. | SAMPLE | BHEL SPEC., IS-8130 | BHEL SPEC., IS-8130 | LOG BOOK | 2 | - | 1 | |
| | | 2. CHEMICAL TEST FOR TINNING | CR | CHEMICAL TEST | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| 2.2 | STRANDING OF WIRES | 1. NO. OF WIRES | MA | COUNTING | SAMPLE | VENDORS/ BHEL SPEC. & APPD. DATA SHEET & RELEVANT IS | VENDORS/ BHEL SPEC. & APPD. DATA SHEET & RELEVANT IS | LOG BOOK | 2 | - | - | |
| | | 2 SEQUENCE,LAY LENGTH AND DIRECTION | MA | VISUAL, MEAS | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| | | 3. SURFACE FINISH | MA | VISUAL | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| | | 4. DIMENSION | MA | MEASURE-MENT | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| 2.3 | CORE - INSULATION (NO REPAIR PERMITTED) | 1 SURFACE FINISH | MA | VISUAL | 100% | - | FREE FROM BULGING, BURNT PARTICLES LUMPS, CUTS & SCRATCHES | -DO- | 2 | - | 1 | |
| | | 2. INSULATION THICKNESS | CR | MEASUREMENT | SAMPLE | APPD.DATA SHT. IS : 1554 | APPD.DATA SHT. IS : 1554 | -DO- | 2 | - | - | |

| BHEL | PARTICULARS | BIDDER / VENDOR | |
|---|---|---|---|
| | NAME | | |
| | SIGNATURE | | |
| TENDER NO PSER:SCT:NBN-C2067:20 | DATE | | BIDDER'S / VENDOR'S COMPANY SEAL |

FORM No. PEM 6041–0

| | QUALITY PLAN | CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|---|---|
| | | BIDDER / VENDOR | QUALITY PLAN NUMBER PED–507–00–Q–002 / 02 | SPECIFICATION TITLE |
| | SHEET 3 OF 6 | SYSTEM | ITEM PVC POWER & CONTROL CABLE | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| | | 3. CONCENTRI-CITY. # | CR | MEASUREMENT | SAMPLE | MFR. STD. ./APPD. DATA SHEET. | MFR. STD. /APPD. DATA SHEET. | -DO- | 2 | - | 1 | # TO BE CHECKED AT STARTING & FINISH END OF EXTRUDED LENGTH |
| | | 4. DIA OVER INS-ULATION | MA | MEASUREMENT | SAMPLE | -DO- | -DO- | -DO- | 2 | - | - | |
| | | 5. SPARK TEST OR WATER IMMERSION TEST | CR | ELECTRICAL | 100% | MFR. STD. | MFR. STD. | -DO- | 2 | - | 1 | |
| | | 6. CORE IDENTIF-ICATION. | MA | VISUAL | 100% | IS:1554 | IS:1554 | -DO- | 2 | - | - | |
| 2.4 | CORE - LAYING | 1.DIA OVER LAID UP CORE | MA | MEASUREMENT | SAMPLE | -DO- | -DO- | -DO- | 2 | - | - | |
| | | 2.SEQUENCE OF LAY, LAY LENGTH & DIRECTION UP CORE | MA | VISUAL & MEAS. | SAMPLE | MFR. STD/ RELEVANT IS | MFR. STD/ RELEVANT IS | LOG BOOK | 2 | - | - | |
| 2.5 | INNER SHEATH EXTRUSION | 1. SURFACE FINISH | MA | VISUAL | 100% | – | FREE FROM BULGING,BURNT PARTICLES, LUMPS CUTS & SCRATCHES | -DO- | 2 | - | - | |
| | | 2. SHEATH THICKNESS | MA | MEASUREMENT | SAMPLE | IS:5831 & DATA SHEET IS-1554 | IS:5831 & DATA SHEET IS-1554 | -DO- | 2 | - | - | |
| | | 3. DIA OVER INN-ER SHEATH | MA | -DO- | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| 2.6 | ARMOURING | 1. NO. OF WIRES/ STRIPS | MA | COUNTING | AT THE START OF THE PROCESS | BHEL SPEC./ APPD.DATA SH. IS:3975 & IS:1554 | BHEL SPEC./ APPD.DATA SH. IS:3975 & IS:1554 | -DO- | 2 | - | - | |
| | | 2. LAY DIRECTION | MA | VISUAL | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |

| BHEL | PARTICULARS | BIDDER / VENDOR | |
|---|---|---|---|
| | NAME | | |
| | SIGNATURE | | |
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| | QUALITY PLAN | CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|---|---|
| | | BIDDER / VENDOR | QUALITY PLAN NUMBER PED–507–00–Q–002 / 02 | SPECIFICATION TITLE |
| | SHEET 4 OF 6 | SYSTEM | ITEM PVC POWER & CONTROL CABLE | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| | | 3. LAY LENGTH | MA | VISUAL, MEAS. | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| | | 4. COVERAGE | MA | MEASUREMENT | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| | | 5. DIA OVER - ARMOURING | MA | MEASUREMENT | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| 2.7 | OUTER SHEATH EXTRUSION | 1. SURFACE FINISH | MA | VISUAL | 100% | - | FREE FROM BUL-GING, BURNT PA-RTICLES, LUMPS CUTS & SCRATC-HES. | LOG BOOK | 2 | - | - | |
| | | 2. SHEATH THICK-NESS | MA | MEASUREMENT | SAMPLE | IS:5831 & IS-1554 DATA SHEET | IS:5831 & IS-1554 DATA SHEET | -DO- | 2 | - | - | |
| | | 3.DIA OVER OUT-ER SHEATH | MA | -DO- | -DO- | -DO- | -DO- | -DO- | 2 | - | - | |
| | | 4. MARKING | MA | VISUAL | 100% | IS:1554 & BHEL SPEC. | IS:1554 & BHEL SPEC. | TEST REPORT | 2 | - | - | SEQUENTIAL MARKING SHALL BE DONE BY PRINTING. |
| 2.8 | FINISHED CABLE | 1. ROUTINE TEST | CR | ELEC. & MEAS. | 100% | IS:1554 & BHEL SPEC. | IS:1554 & BHEL SPEC. | TEST REPORT | 2 | - | 1 | |
| | | 2.TYPE AND FRLS TESTS | CR | ELEC. PHY & MEAS | SAMPLE * | -DO-/APPD. DATA SHEET. | -DO-/APPD.DATA SHEET. | -DO- | 2 | - | 1 | *ONE DRUM / SIZE / LOT |
| 3.0 | FINAL INSPECTION | 1. FINISH & LENGTH | MA | VISUAL | (SEE REMARK ) | BHEL SPEC. IS: 1554 | FREE FROM BULGING,BURNT PARTICLES LUMPS CUTS & SCRATC-HES. | -DO- | 2 | 1 | - | ONE DRUM EACH FOR POWER AND CONTROL CABLES IN A LOT |

| BHEL | PARTICULARS | BIDDER / VENDOR | |
|---|---|---|---|
| | NAME | | |
| | SIGNATURE | | |
| TENDER NO PSER:SCT:NBN-C2067:20 | DATE | | BIDDER'S / VENDOR'S COMPANY SEAL |

FORM No. PEM 6041–0

| | QUALITY PLAN | CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|---|---|
| | | BIDDER / VENDOR | QUALITY PLAN NUMBER PED–507–00–Q–002 / 02 | SPECIFICATION TITLE |
| | SHEET 5 OF 6 | SYSTEM | ITEM PVC POWER & CONTROL CABLE | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY P | AGENCY W | AGENCY V | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| | | 2. DIMENSION | MA | MEASUREMENT | AS PER IS | APPD.DATA SHEET. IS:1554 IS:10810 | APPD.DATA SHEET. IS:1554 IS:10810 | -DO- | 2 | 1 | - | |
| | | 3. ARMOURING-COVERAGE NO.OF WIRES /STRIPS | MA | VISUAL & MEAS. | AS PER IS | -DO- | -DO- | -DO- | 2 | 1 | - | |
| | | 4.MARKING/COL-OUR CODING | MA | VISUAL | -DO- | -DO- | -DO- | -DO- | 2 | 1 | - | |
| | | 5 ACCEPTANCE TESTS | CR | PHY. & ELECT. TESTS | -D0- | -DO- | -DO- | -DO- | 2 | 1 | | |
| | | 6. TYPE & FRLS TESTS | CR | MEASUREMENT | (SEE REMARK) | BHEL SPEC. , APPD. DATA SHEET | BHEL SPEC. APPD. DATA SHEET | -DO- | 2 | 1 | - | TYPE TEST SHELL BE WITNESSED ON ONE SAMPLE PER TYPE (POWER / CONTROL) OF EVERY LOT. |

| BHEL | PARTICULARS | BIDDER / VENDOR | |
|---|---|---|---|
| | NAME | | |
| | SIGNATURE | | |
| TENDER NO PSER:SCT:NBN-C2067:20 | DATE | | BIDDER'S / VENDOR'S COMPANY SEAL |

FORM No. PEM 6041–0

| | QUALITY PLAN | CUSTOMER | PROJECT TITLE | SPECIFICATION NUMBER |
|---|---|---|---|---|
| | | BIDDER / VENDOR | QUALITY PLAN NUMBER PED–507–00–Q–002 / 02 | SPECIFICATION TITLE |
| | SHEET 6 OF 6 | SYSTEM | ITEM PVC POWER & CONTROL CABLE | SECTION VOLUME III |

| S. NO. | COMPONENT / OPERATION | CHARACTE–RISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| | | | | | | | | | | | | |

NOTES:

A) JOINTS IN WIRES SHALL BE AS PERMITTED BY IS/BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME
B) NO REPAIR OF CORE INSULATION FERMITTED.
C) CABLE ENDS SHALL BE SEALED AS PER BHEL SPECIFICATION.
D) PURCHASER SHALL HAVE RIGHT TO WITNESS THE SPARK TEST AT CORE STAGE.
E) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDOR'S Q.C. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.
F) FILLERS / DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION.
G) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES, THE SAME SHALL BE AS PER VENDOR'S SAMPLING PLAN.
H) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION.

LEGEND :– P – PERFORMER : W–WITNESSER : V – VERIFYER:
1–BHEL/BHEL'S CUSTOMER : 2– VENDOR : 3–SUB VENDOR

| BHEL | PARTICULARS | BIDDER / VENDOR | |
|---|---|---|---|
| | NAME | | |
| | SIGNATURE | | |
| TENDER NO PSER:SCT:NBN-C2067:20 | DATE | | BIDDER'S / VENDOR'S COMPANY SEAL |

| | | |
|---|---|---|
| L&T | | SPECIFICATION NO. PES-506-05 |
| | | VOLUME II B |
| | | SECTION D |
| | | REV NO. 0 DATE 11.02.2002 |
| | | SHEET 1 OF 1 |

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not an exact copy.

# GENERAL TECHNICAL REQUIREMENTS
# OF
# 415 V AC DISTRIBUTION BOARD

## SPECIFICATION NO. PES-506-05
## (7 SHEETS)

| TITLE | SPECIFICATION NO. PES-506-05 | |
|---|---|---|
| 415 V AC DISTRIBUTION BOARD | VOLUME | II B |
| | SECTION | D |
| | REV NO. 0 | DATE 11.02.2002 |
| | SHEET 1 OF 3 | |

## 1.0 SCOPE

This specification covers the design, manufacture, assembly, testing, packing & despatch of AC Distribution Boards complete in all respect with all components, fittings & accessories for efficient and trouble free operation.

## 2.0 STANDARDS

Major standards which shall be followed are listed below. Other applicable standards for any component, if not covered in the listed standards, shall also be followed.

| | |
|---|---|
| IS:375 | Marking& arrangement for swgr. busbars, main connections & aux. Wiring |
| IS:4064 | Air-break switches, disconnectors switch-disconnectors & fuse combination units |
| IS:2147 | Degree of protection provided by enclosures |
| IS:8623 | Factory built assemblies of switchgear & controlgear |

## 3.0 CONSTRUCTIONAL FEATURES

### 3.1 GENERAL REQUIREMENTS

ACDBs shall be of single front contruction having a continuous line-up of vertical sections housing switch-fuse modules only. ACDBs shall have duplicate incomers and a bus-section.In-cubicle rating of incomer and bus-section switches shall be identical to the associated busbar rating.Outgoing feeders shall be such so as to ensure uniform loading on each section DB.

ACDBs shall be indoor, air insulated, metal-clad and fixed type suitable for floor mounting.It shall conform to the degree of protection IP:54. Panels shall be fabricated from minimum 2mm thick CRCA sheet steel.

DB shall be front wired and front connected. They shall be fully compartmentalised with metal insulating partitions between compartments. Working height shall be limited between 450mm and 1800mm from floor level.

All instruments, switches etc. mounted on the front face of the panels shall be of flush type.

Each panel shall be provided with internal illumination lamp operated by door switch, space heater and switchfuse unit and plug socket with switch for hand lamp.

DBs shall be supplied with base frame made out of structural steel sections along with all necessary mounting hardware required for bolting/welding the base frames to the foundation.

### 3.2 BUSBARS & CONNECTIONS

Busbars shall be sized to carry continuously the total running load of the ACDB plus a 20% margin. The minimum clearance in air between phases and between phases and

earth for entire run of horizontal and vertical busbars shall be 25mm. Horizontal and vertical busbars and bus connections shall be of high conductivity copper/ aluminium alloy. Maximum temperature shall be limited to 90 deg C.

## 3.3 PANEL WIRING

All panels shall be fully wired at the factory to ensure proper functioning of all control, protection and interlock schemes. All wiring for external connection shall be brought to terminal blocks and numbered.

Panel wiring shall be carried out with flexible heat resistant 650V grade, PVC insulated stranded copper wire of minimum 2.5sq.mm cross-section.

Solderless compression /clamp type connection shall be used for wire terminals. Wiring shall be continuous between terminals without splicing. Each wire shall be identified at both ends with permanent markers having wire numbers as per approved wiring drawings.

Terminal blocks shall be box clamp type with marking strip. Not more than two wires shall be connected to one terminal. Spare terminals equal in number to 20% of active terminals shall be furnished.

## 3.4 GROUNDING

A copper ground bus, sized to carry maximum short circuit current shall run along the entire length of panel structure and shall have terminal connection at each end for connection to station ground grid (50x6 mm GI flat).

## 3.5 NAME PLATE

Name plates of approved design shall be furnished on each panel and for each instrument or device mounted on panel.

The material shall be lanucoid or approved equal 3mm thick with white letters on black background.

Name plates shall be held by self tapping screws. Name plates size shall be minimum 20x75mm for instruments devices and 40x50mm for panels.

# 4.0 SWITCHGEAR COMPONENTS

## 4.1 SWITCHES

Switches shall be triple/double pole air break type.

The switch shall have a quick-make, quick-break mechanism operated by a suitable external handle, complete with position indicator. This handle shall have provision for padlocking in ON & OFF position.

The compartment door shall be interlocked mechanically with the switch such that the door cannot be opened unless the switch is in OFF position . Means shall be provided for releasing the interlock at any time.

Switches shall be capable of withstanding the through fault current of back up fuse.

Wherever two incoming switches and one bus-section switch are provided for an assembly, these shall be mechanically/key interlocked to ensure that only two out of three can be closed at a time.

## 4.2 FUSES

Fuses shall be HRC, preferably link type with a minimum interrupting capacity equal to short circuit current of the LV system.

Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

The fuse on incoming feeder wherever provided shall be chosen to provide discrimination with outgoing feeder fuses.

## 4.3 METERS & METER SELECTOR SWITCHES

All indicating instruments (96x96mm) shall be switchboard types with 250deg. Scale, antiglare glass and accuracy class of ±2% full scale. Each meter shall have zero adjuster on the front.

Meter selector switches shall be maintained contact, stay-put type with knob handle. Voltmeter selector switches shall be four position type.

## 5.0 PAINTING

All metal surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of synthetic enamel paint in light grey shade (IS:5 shade 631).

## 6.0 TESTS

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| | 415 V AC DISTRIBUTION BOARD | VOLUME II B |
| | | SECTION D |
| | (DATA SHEET – A) | REV NO. / DATE |
| | | SHEET 1 OF 1 |

| | | | |
|---|---|---|---|
| 1.0 | GENERAL | | |
| 1.1 | Type | : | Fixed Type |
| 1.2 | Service | : | Indoor |
| 1.3 | Enclosure | : | IP-54 |
| 2.0 | SYSTEM | | |
| 2.1 | Voltage | : | 415 V±10% |
| 2.2 | Phase | : | 3 |
| 2.3 | Frequency | : | 50Hz±5% |
| 2.4 | System | : | Solidly grounded |
| 3.0 | RATED CURRENT AT 50 DEG.C | | |
| 31. | Busbar | : | to be decided by tenderer |
| 3.2 | Switches | : | to be decided by tenderer |
| 4.0 | SHORT CIRCUIT RATING | | |
| 4.1 | Interrupting | : | 50kA |
| 4.2 | Short time for 1sec. | : | 50kA |
| 5.0 | INSULATION LEVEL | : | 2.5kV for 1min |

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| | 415 V AC DISTRIBUTION BOARD | VOLUME II B |
| | | SECTION D |
| | DATA SHEET C/B | REV NO. / DATE |
| | | SHEET 1 OF 3 |

1.0 EQUIPMENT

1.1 Make :

1.2 Type :

1.3 Reference Standard :

1.4 Construction

a/ Degree of protection :

b/ Sheet metal thickness (mm):

c/ Floor channel sills vibration damping pads & kick plate furnished

1.5 Whether all equipment are flush: Mounted

1.6 Name plate

a/ Material :

b/ Thickness :

c/ Size for

-Equipment :

-Panels :

1.7 Internal illumination

a/ Volt :

b/ Watt :

c/ Door switch controlled :

1.8 Space Heater :

a/ Volt :

b/ Watt :

c/ Thermostat controlled :

1.9 Plug Socket :

a/ Type :

b/ Rating :

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1.10 Type & rating of isolating Switch-fuse units for incoming AC supply

1.11 Internal Wiring :
a/ Wire type :
b/ Voltage grade :
c/ Conductor material :
d/ Conductor size for :
-Current control circuit :
-Voltage circuit :

1.12 Terminal Block
a/ Make :
b/ Type :
c/ 20% spare terminals furnished

1.13 Ground Bus
a/ Material
b/ Size

1.14 Painting
a/ Type of finish
b/ Colour shade

2.0 SWITCHES
2.1 Make
2.2 Type
2.3 Reference standard
2.4 Breaking current at 415V AC

3.0 FUSE
3.1 Make
3.2 Type

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| | |
|---|---|
| 3.3 | Reference standard |
| 3.4 | Rupturing capacity (kA rms) |
| 3.5 | Cont. current at 50deg.C ambient and within cubicle (Amp.) |
| 3.6 | Cut-off currents (kA peak) |
| 3.7 | Whether fuse characteristics furnished |
| 4.0 | METER SELECTOR SWITCH |
| 4.1 | Make |
| 4.2 | Type |
| 4.3 | Reference standard |
| 4.4 | Contact rating |
| | a/ Make & continuous (Amp.) |
| | b/ Break inductive (Amp.) |
| 5.0 | INDICATING INSTRUMENT |
| 5.1 | Make |
| 5.2 | Type |
| 5.3 | Reference Standard |
| 5.4 | Type of movement |
| 5.5 | Accuracy class |
| 5.6 | Scale in degrees |
| 5.7 | VA barden |

| | TITLE: | |
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| | **LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL** | SPECIFICATION NO. PES-558-01A<br>VOLUME - II B<br>SECTION - D<br>REV.NO. 0 DATE<br>SHEET 1 OF |

GENERAL TECHNICAL REQUIREMENTS

OF

LIGHTING DISTRIBUTION BOARD
&
LIGHTING PANEL

SPECIFICATION NO. PES-559-01A

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## 1.0 SCOPE

This specification covers the design, manufacture, assembly, testing, packing & despatch, installation & commissioning of AC Lighting Distribution Boards complete in all respect with all components, fittings & accessories for efficient and trouble free operation.

## 2.0 STANDARDS

Unless specified otherwise, the latest revisions of standards, codes and other applicable statutory rules and regulations specified in Annexure-I of Data Sheet A are applicable and shall be referred to.

## 3.0 Light Distribution Boards (LDBs)

### 3.1 General Requirements

3.1.1 LDBs shall be totally enclosed, modular in construction, indoor type and suitable for electrical system data as specified in Data Sheet A. The LDB shall be free standing type suitable for installation on cable trenches / floor.

3.1.2 LDBs shall be constructed from CRCA sheet and structural sections. Sheet thickness for load bearing members shall be 2.0 mm and that for non-load bearing members shall be 1.6 mm, unless specified otherwise in Data Sheet A. The design and construction of LDBs shall ensure adequate rigidity.

3.1.3 Vertical cable chambers / alleys of adequate width but not less than 250 mm shall be provided for incoming / outgoing cables of each panel.

3.1.4 LDBs shall have only one operational front. Door shall be provided at the front of each module to give full access to all the components.

3.1.5 LDBs shall consist of dust and vermin proof cubicles without the use of louvers (except the transformer compartment, where applicable).

3.1.6 Good quality synthetic rubber / neoprene gaskets shall be put around the door, cover edges and cutout edges for pushbutton, lamps etc. for protection against dust. The door when closed, shall compress the gasket uniformly.

3.1.7 Cutout edges for instruments, relays etc. shall have sufficient overlap surface to minimize the dust entry. The arrangement for the front mounting of switch handles shall render the LDB reasonably dust free such that the normal operations are not affected.

3.1.8 Degree of protection for completed LDBs (Distribution Board) shall be IP:52 unless mentioned otherwise in Data Sheet A.

3.1.9 The LDBs shall be designed to prevent contact with live parts both within the modules and in the cable alley.

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3.1.10 The ratings of all components shown in the enclosed drawings are indicative only. The bidder shall be responsible to check and coordinate the MCB characteristic with back up fuses etc. provided. Any change in size / ratings of components required for final arrangement may be complied with and provided by the vendor at no extra cost.

3.1.11 All equipment shall be constructed of non-hygroscopic and non-inflammable materials.

3.1.12 All components mounted in the LDBs shall be accessible and shall not impede access to wiring or terminals. All faults except busbar fault which may occur within any individual unit shall be confined within that unit only and shall not cause shutdown of any section of the board other than the affected unit itself. Maintenance and inspection shall be possible in any individual unit without affecting other units.

3.1.13 Incoming unit shall comprise of either switch-fuse / composite fuse-switch unit or MCCB as per scheme / Data Sheet A. Outgoing units shall be a switch-fuse / composite fuse-switch unit / MCB.

3.1.14 The rated continuous current of the equipment and components shall be as given in the schemes. These ratings shall be obtained with the components mounted in their housing as in service without exceeding the permissible temperature rise.

3.1.15 Interlock between compartment door and modules shall be provided such that the door cannot be opened without switching off the power supply to the module.

3.1.16 Defeat interlock shall be provided for the units comprising of switch or moulded case circuit breaker as a means of isolation device, such that it is possible to open the door with device ON. It shall not be possible to close the door till the interlock has been reinstated.

3.1.17 Each LDB shall be fitted with base frame made of angle or channel.

3.1.18 All fixing nuts and bolts together with grounding bolts shall be provided.

3.1.19 Lifting lugs shall be provided for each shipping section of LDB. Removal of such lugs or hooks shall leave no opening in the LDB.

3.2 LDBs with transformers (Additional Features)

3.2.1 The lighting distribution board shall be arranged in two adjacent but separate compartments, one compartment for the lighting transformer and the other for the incoming & outgoing feeders etc.

3.2.2 The transformer shall be mounted on the base channel and it shall be possible to easily remove the transformer from the cubicle after opening the door. Necessary portable ramp made of mild steel shall be supplied along with each LDB.

3.2.3 Independent gasketted hinged door with operating handle shall be provided for access to transformer & its taps. Operating handle shall have built-in key locking arrangement.

3.2.4 Suitable ventilation arrangement for the transformer compartment to dissipate the heat of the transformer shall be provided. The arrangement shall be in the form of louvers and the same shall be provided with galvanized wire mesh with dust catchers on the inside.

3.2.5 The degree of protection for transformer compartment shall be IP:42 unless mentioned otherwise in Data Sheet A.

3.2.6 Connections between transformer secondary terminals and the busbars shall be made by using PVC insulated flexible copper cables or busbars.

3.2.7 Warning plate shall be provided on transformer enclosure. The inscription of warning plate shall be as given below:

- DO NOT OPEN DOORS WHEN ENERGISED

- KEEP TAPS AT SAME POSITION FOR ALL PHASES

3.2.8 Transformer enclosure shall be provided with a danger plate.

3.3 Lighting Transformer

3.3.1 Lighting transformer, where specified shall form an integral part of lighting distribution board.

3.3.2 Lighting transformer shall be dry type, natural air cooled and suitable for mounting inside the lighting distribution board. Transformer shall be non-encapsulated type, unless specified otherwise in Data Sheet A.

3.3.3 Rating of transformer shall be 50 kVA as per type of LDB.

3.3.4 Voltage rating shall be given in Data Sheet A.

3.3.5 Percentage impedance shall be 3% for 50kVA and 4% for 100 kVA transformers, unless specified otherwise in Data Sheet A.

3.3.6 Off circuit tap changers/links shall be provided for $\pm$ 5% in steps of 2.5%.

3.3.7 Transformer winding insulation shall be class “F” or better.

3.3.8 Transformer shall be of vector group Dynl.

3.3.9 Winding shall be of copper material maximum winding temperature at full load and under site conditions shall not exceed 120 Deg. C.

3.3.10 Transformer shall be suitable for cable connections on the primary side and flexible cable or busbar connectin on the secondary side.

3.3.11 The secondary neutral of the transformer shall be brought out for getting a grounded 4 wire supply system.

3.3.12 The transformer neutral shall be brought outside the LDB for earthing. The neutral busbar shall be insulated from the LDB enclosure.

3.3.13 Transformer shall be provided with the rollers, pulling holes, lifting lugs, jacking positions etc.

3.4 Busbars, Connections and Joints

3.4.1 Busbars shall be made of aluminium grade E 91E or high conductivity copper (ETC), Busbar material shall generally be aluminium unless mentioned otherwise in Data Sheet A.

3.4.2 Busbars shall be supported on non-hygroscopic and non-inflammable insulators of material such as glass reinforced moulded plastic material, epoxy cast resin etc. Separate supports shall be provided for each phase of the busbars, Insulation level of neutral busbar shall be same as that of phase busbars.

3.4.3 Busbars shall be contained in a separate vermin-proof compartment within the LDB and shall have bolted sheet steel covers for providing suitable access.

3.4.4 Busbar clearances in the air shall be as per applicable standard for 500V, 3 phase system.

3.4.5 Temperature of busbars, droppers and connections shall not exceed 90 Deg. C for an ambient of 50 Deg. C while carrying maximum continuous current.

3.4.6 The busbar, busbar connections and supports shall have sufficient strength to withstand thermal and electromechanical stresses produced by the specified short circuit level of the system.

3.4.7 Busbars (including neutral busbar) shall be capable of carrying the short-time current specified in Data Sheet A. The duration of short-time current shall be 1 sec unless mentioned otherwise in Data Sheet A. For the specified current and duration, there shall be no damage to the equipment.

3.4.8 The neutral bus shall be rated same as phase bus.

3.4.9 Main busbars and connections shall be prominently marked and displaced for standard sequence counting from rear to front top to bottom, or left to right as viewed from the switching device operating mechanism side.

3.4.10 Busbars and connections shall be provided with colour coded PVD sleeves. All live parts shall be properly shrouded with insulating material.

3.4.11 Earth busbar shall be provided separately. Material of earth busbar shall be GI unless mentioned otherwise in Data Sheet A.

3.4.12 Busbar Joints

a) Busbar and tap off joints shall be bolted type.

b) Busbars shall be thoroughly cleaned before jointing. Suitable contact greae shall be applied to remove oxide film just before jointing.

c) For copper busbars, the connecting portion shall be tinned or silver plated.

3.5 Wiring and Terminals

3.5.1 All internal wiring for connections to remote equipment shall be brought to terminal boards. Spare contacts of devices shall also be wired upto terminal board as per schemes. Wires shall not be jointed or teed-off except at terminal points.

3.5.2 Wiring shall be made by 1000 volt grade three / seven strand PVC insulated copper wire having a cross-sectional area of not less that 1.5 sq.mm. All connections from CT leads upto instruments, terminals shall be made by copper wires of minimum 2.5 sq.mm. size.

3.5.3 All wiring shall be made with the Colour Codes specified below:

a) 3 phase AC Connections

| | |
|---|---|
| Phase 1 ( R ) | Red |
| Phase 2 ( Y) | Yellow |
| Phase 1 ( B ) | Blue |
| Neutral | Black |

b) 1 phase AC Connections

Phase Red/ Yellow / Blue
(as per associated circuit)
Neutral Black

c) DC Connections

| | |
|---|---|
| Positive | While |
| Negative | Grey |

d) Earth Connection Green

3.5.4 Where wiring passes from one compartment to another, the aperture shall be 'Bushed' to prevent damage to wires against sheet metal edges. Bushes may comprise of good quality rubber/ PVC grommets.

3.5.5 Every wire end shall be fitted with numbered ferrules of white or yellow colour having glossy finish with identification number engraved in black, Ferrules shall be made of moisture and oil resisting insulating material. Ferrules shall be or interlocked type or tight fitting type. Ferrules shall be so fitted that they will not get detached, when the wire is removed from the terminal.

3.5.6 System of marking of wiring shall be as per applicable standard.

3.5.7 All wires used internally shall have crimped on tinned copper lugs for terminations.

3.5.8 Terminal boards shall be stud type with insulating barriers of adequate height.

3.5.9 Terminal boards shall have separate terminals for incoming and outgoing wires with not more than two wires connected to any one terminal.

3.5.10 Terminal boards shall be mounted vertically or in the horizontal rows and properly spaced to have clean wiring arrangement, adequate access for putting ferrules, making terminations etc. It shall be possible to read the ferrule numbers when the wiring is complete. Where terminals may be live when the equipment is isolated from the main supply, these shall be clearly marked near the terminal boards.

3.6 Controls

The controls shall be provided as per purchaser's requirements covered in the specification and control schemes.

3.7 Switch Fuse Units

3.7.1 These units shall preferably comprise of switches having integral fuses, called composite units. Alternatively, combination units of separate switch and fuse may also be acceptable.

3.7.2 These units shall be provided for general purpose i.e. incoming or outgoing units.

3.7.3 The units shall be of the air break air insulated type and designed to ensure safety to operating personnel.

3.7.4 Composite units shall have integral fuses i.e. fuse carrier with fuse link (fuse link forming the moving contact). The design shall ensure that the moving contact is not live when switch is open i.e. in OFF position, so as to facilitate removal of fuse.

3.7.5 The switch shall be capable making and carrying the system prospective fault current, but limited in magnitude and duration by the cut off characteristics of the largest HRC fuse link that may be fitted to that unit.

3.7.6 The fixed contact shall be so shrouded that maintenance of the unit can be carried out in safety with the busbars live.

3.7.7 Where one isolating switch is used as the incoming device, the incoming side fixed contacts shall be shrouded to ensure that maintenance can be carried out with the remote fuse and switch closed.

3.7.8 Composite switch-fuse or the combination of switch and fuse shall meet the requirements of its components as follows:

3.7.9 Isolating Switch

a) Switches shall be air-break, quick make, quick break heavy duty type conforming to applicable standard.

b) All switches shall have visible ON / OFF position indication and shall be padlockable in any (ON /OFF) position.

c) Switches shall be door interlocked such that it shall not be possible to gain access to inside the unit unless the isolating switch is in OFF position.

d) The switches shall be suitable for independent manual operation.

e) The switch contacts shall be of silver alloy or silver plated copper and springs of non corrosive material.

f) Inter-phase barriers shall be provided to prevent possibilities of phase to phase fault in the switch. The switch shall also be shrouded from all sides to prevent access to live parts on the switch after opening the unit door. The barriers and shrouding shall extend upto the height of switch to fully enclose both side terminals of the device. The arrangement shall permit easy maintenance.

3.7.10 High Rupturing Capacity (HRC) Fuses

a) The fuse serving as the short-circuit protective device in isolating fuse-switch units shall be of HRC cartridge, current limiting and plug-in non-deteriorating type.

b) The fuse carriers shall be easily withdrawable for replacement of fuse, Insulated fuse pullers shall be provided where fuses are not mounted in insulating carriers to remove and replace fuses in live conditions.

c) Fuses shall preferably be fitted with a device to indicate operation (i.e. when the fuse has blown).

d) Live terminals of fuse bases shall be shrouded to prevent contact with personnel where fuse links are not mounted in carriers and are directly plugged into the fuse base. Inter-phase barriers extending throughout the length of the fuse base shall be provided to prevent inter-phase short circuit. They shall be shrouded from all sides to prevent accidental contact.

e) Fuse carriers and bases shall be of good quality moulded insulating material. Porcelain fuse bases and carriers will not be accepted.

3.8 Cable Terminations

3.8.1 All cable, either incoming or outgoing to the LDB, shall be terminated in a cable chamber. For each panel, there shall be a cable chamber on the side. The door of cable chamber should open or be locked with the help of a tool. Unless stated otherwise in Data Sheet A, all cables shall enter from the bottom.

3.8.2 Removable undrilled gland plates of sheet steel shall be provided in the cable chamber for entry of cables. Minimum thickness of gland plate shall be 3mm. The gland plate shall be of adequate size for connecting requisite number of cable glands for power and control cables.

3.8.3 Heavy duty bolt-on termination tinned copper lugs of compression type shall be used in for power cable termination.

3.8.4 For supporting and clamping of cable cores at regular interval in cable alleys, suitable slotted angle upto the respective terminal blocks shall be provided.

3.8.5 The supply of tinned copper cable lugs for power cables from part the supply of equipment.

3.9 Earthing

3.9.1 An earth busbar of adequate size of galvanized MS shall be provided at the bottom for the entire length of the LDB.

3.9.2 Every metal part other than those forming parts of an electrical circuit shall connected to the earth bus by means of high conductivity copper wire of size not less than 2.5 sq. mm cross-sectional area.

3.9.3 Doors shall have a flexible copper wire for earth connection to fixed unit.

3.9.4 Each LDB shall be fitted with two earthing studs located in accessible position on sides for connection of internal earth busbar to the external earthing connection.

3.9.5 Earth busbar shall be brought outside LDB for making external connections.

3.10 Type of LDBs

The LDBs shall be of following type:

a) LDB-H (n) - AC LDB with 100 kVA transformer

b) LDB-F (n) - AC LDB with 50 kVA transformer

c) LDB-N (n) - AC LDB with no transformer

d) LDB-D (n) - DC LDB

NOTE: (n) indicates number of outgoing feeders.

3.10.1 AC LDBs (LDB-H, LDB-F, LDB-N)

Each LDB shall comprise of the following and comply with the enclosed single line diagrams:

a) One lighting transformer (LDB-H & LDB-F)
LIGHTING SYSTEM

b) One incomer of TP / TPN switch-fuse unit or MCCB / MCCB with neutral link as per Data Sheet A. It shall be provided on the primary side of transformer for LDB type LDB-H & LDB-F.

c) Set of busbars with 3 phase and neutral.

d) TPN switchfuse units for each outgoing circuit.

e) Three indicating lamps with fuses for indicating bus supply ON.

f) CT operated ammeter with selector switch.

g) VT operated voltmeter with selector switch.

h) Power & control terminals, earth-stud, earth busbar, designation labels, internal wiring, power cable lugs, glands etc. shall be provided to complete the LDB in all respects.

3.10.2 DC LDBs (LDB-D)

Each LDB shall comprise of the following and comply with the enclosed single line diagrams:;

a) One incomer of two pole switch-fuse unit.

b) Two pole DC contactor on the incoming circuit for changeover to DC in case of AC normal supply failure.

c) One under voltage relay of suitable range, if specified in Data Sheet A.

d) One ON delay timer.

e) One test push button.

f) Set of busbars for positive and negative.

g) Two pole switch-fuse units / MCB for outgoing feeders.

h) Two indicating lamps with fuses for indicating but supply ON.

i) Power & control terminals, earth busbar, designation labels, internal wiring, power cable lugs, glands etc. shall be provided to complete the LDB in all respects.

4.0 LIGHTING PANELS (LPs)

4.1 General Requirements of Lighting Panels

4.1.1. LPs shall be totally enclosed, suitable for electrical system data as specified ind Data Sheet A.

4.1.2 Panels shall be suitable for indoor / outdoor application as per Data Sheet A and BOQ. Outdoor panels shall have a sloping canopy.

4.1.3 LPs shall be constructed from CRCA sheet. Sheet thickness shall be 2.0mm, unless mentioned otherwise in Data Sheet A. The construction of LPs shall ensure adequate rigidity.

4.1.4 All components of the LP shall be fully mounted inside the panel, LPs shall have only one operational front. Door shall be provided to give full access to all the components. Door shall have padlocking arrangement.

4.1.5 LPs shall consist of dust and vermin proof cubicles without the use of louvers.

4.16 Good quality synthetic rubber / neoprene gaskets shall be put around the door. The door when closed, shall compress the gasket uniformity.

4.17 Unless mentioned otherwise in Data Sheet A, degree of protection for completed LPs shall be IP:52 for indoor LPs and IP:55 (with weather-proof protection & canopy) for outdoor LPs.

4.1.8 The LPs shall be designed to prevent contact with live parts when the front door is open.

4.1.9 All busbars (phase, neutral, positive, negative as applicable) within a panel shall be of the same size.

4.1.10 All control wiring inside the panels shall be carried out with 1100 V grade, PVC insulated flexible copper wire of 2.5 sq.mm size.

4.1.11 The rated continuous current of the equipment and components

4.1.12 Each LP shall be fitted with MS. Mounting brackets.

4.1.13 Panel shall be suitable for top / bottom cable / conduit entires. However, outdoor LPs shall have bottom cable / conduit entry. Removable undrilled undrilled gland plate of sheet steel shall be provided for entry of cables. Minimum thickness of gland plate shall be 3 mm. The gland plate shall be of adequate size having knock-outs for requisite number cable connections. Gland plate shall be provided with gasket.

4.1.14 The lighting panel shall be complete with copper busbars, and shall incorporate switch fuse or MCB on the incoming side, single pole miniature circuit breakers (MCBs) for AC outgoing circuits and double pole MCBs for DC outgoing circuits. Number of outgoing circuits shall be as per BOQ.

4.1.15 Each lighting panel shall be fitting with two GI earth studs located in accessible position on the outside of the panel on opposite sides.

4.1.16 All metal parts of the panel except current carrying parts shall be bonded together electrically to the earthing stud.

4.1.17 Each panel shall be fitted with phase barriers of fireproof insulating material in such a manner that it is not readily possible for personnel to touch the phase busbars.

Insulating sheet shall be fitted around the MCBs such that only the surface and toggle of the MCBs are available on the front.

4.1.18 The supply of cable lugs for power and control cable connections forms part the supply of equipment.

4.1.19 Each panel shall be provided with a circuit directory plate with inscriptions neatly typed and laminated fitted on the inside of door.

4.2 Type of Lighting Panels

| | | | | |
|---|---|---|---|---|
| a) | LP-A (n) | - | AC | Lighting Panel |
| b) | LP-D (n) | - | DC | Lighting Panel |
| c) | LP-F (n) | - | Fancy | Lighting Panel (Decorative) |
| d) | LP-V (n) | - | Aviation | Lighting Panel |

NOTE: (n) indicates number of outgoing circuits.

4.3 AC Lighting Panel (LP-A)

4.3.1 LPs shall be provided with TPN switch as incomer.

4.3.2 Requisite number of single pole MCBs shall be provided for outgoing circuits.

4.3.3 Separate neutral shall be available at terminal block for each outgoing circuit.

4.3.4 Construction of AC Normal and AC Emergency panels shall be same.

4.4 DC Lighting Panels (LP-D)

4.4.1 LPs shall be provided with double pole switch as incomer.

4.4.2 Requisite number of double pole MCBs shall be provided for outgoing circuits.

4.5 Decorative Type Lighting Panels (LP-F)

4.5.1 Decorative lighting panels shall be designed for use in areas like administrative building, service building, canteen, residential premises etc.

4.5.2 Thickness of sheet steel shall be as per manufacturer’s practice.

4.5.3 LPs shall be of tone colour with elegant finish.

4.5.4 LPs shall be provided with TPN switch as incomer and requisite number of MCBs shall be provided for outgoing circuits.

4.5.5 LPs shall be suitable for either surface or flush mounting as per Data Sheet A and BOQ. Flush mounted panels shall have the collared door suitable for matching with the wall.

4.5.6 Lighting Panels may be provided with transparent acrylic cover for operation of MCBs, if asked for in Data Sheet A.

4.5.7 LPs shall be provided with knockouts on the top, bottom and sides.

4.6 Aviation Lighting Panel (LP_V)

4.6.1 Aviation Lighting Panels shall be provided for feeding power supply to Aviation obstruction luminaries.

4.6.2 Each Aviation Lighting Panel shall comprise of the following:

a) One TPN door interlocked switch-use unit. Interlock defeat feature shall also be provided.

b) Three pole AC Contactor

c) 00-24 hrs timer and a photo-electric switch for automatic switching of contactor

d) Three phase & neutral busbars

e) Single pole or three pole MCBs for each outgoing circuit as per Data Sheet A

f) Two lamps for bus supply ON & OFF indications

g) Complete wiring arrangement as per control scheme.

h) Auto-Manual selector switch

i) ON push button

j) OFF push button

k) Photo switch

4.6.3 Switching ON and switching OFF shall be through both 00-24 hrs timer and light sensor in automatic mode.

4.6.4 One number light sensor in weather proof enclosure having IP:55 degree of protection shall be supplied loose along with each SLP.

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4.6.5 Internal power wiring shall be done with PVC insulated Cu wire of suitable size. All control wiring inside the panel shall be carried out with 1100 V grade, PVC insulated flexible copper wires.

5.0 Guaranteed Performance Requirements

5.1 The vendor shall guarantee satisfactory performance of the equipment under all conditions and requirement as laid down by this specification.

5.2 For the general requirements of performance guarantees refer to other parts of the specification.

6.0 PAINTING

(All metal surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of synthetic enamel paint in light grey shade (IS:5 shade 631).

7.0 TESTS

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

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1.0 SYSTEM DESIGN DATA

| | | | | |
|---|---|---|---|---|
| 1.1 | Design Ambient | | : | 50 Deg.C |
| 1.2 | Relative humidity | | : | |
| | a) | Average | : | As per project synopsis |
| | b) | Maximum | : | -do- |

1.3 Details of Operating parameters

| | | | | |
|---|---|---|---|---|
| a) | AC Supply | | | |
| | i. | Rated voltage | : | 415 V |
| | ii. | Rated frequency | : | 50 Hz |
| | iii. | Voltage variation (Permissible) | : | ± 10 % |
| | iv. | Frequency variation (Premissible) | : | ± 5 % |
| | v. | Combined voltage & Frequency variation (sum of absolutes permissible) | : | 10% |
| | vi. | System fault level At rated voltage | : | 50 kA for 0.25 sec. |
| | vii. | System grounding | : | Solidly |
| b) | DC Supply | | | Not applicable |
| | i. | Rated voltage | : | V |
| | ii. | Voltage variation (Permissible) | : | % |
| | iii. | System fault level at rated voltage | : | |
| c) | AC Emergency luminaries as per percentage of total luminaries | | : | Not applicable % |

2.0 APPLICABLE STANDARDS : As per Annexure I

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| | | | | |
|---|---|---|---|---|
| 3.0 | LIGHTING DISTRIBUTION BOARDS | | | |
| 3.1 | Sheet thickness | : | 2.0 | mm |
| 3.2 | Degree of protection | : | | |
| | a) Main panel | : | IP 54 | |
| | b) Transformer cubicle | : | IP 33 | |
| 3.3 | Type of Incomer | : | Switch-Fuse | |
| 3.4 | Type of Outgoing Feeders | : | Switch-Fuse | |
| 3.5 | Voltage rating of transformer | : | 415 V | |
| 3.6 | Whether transformer is encapsulated: | | No | |
| 3.7 | Transformer impedance | | | |
| | a) 100 kVA | : | - | % |
| | b) 50 kVA | : | 4.0 | % |
| 3.8 | Bus bar material | : | Aluminium | |
| 3.9 | Earth busbar material | : | GI (50X6 mm) | |
| 3.10 | Cable entry | : | Bottom | |
| 3.11 | Whether under voltage relay required in DC LDB | : | Not applicable | |
| 4.0 | LIGHTING PANEL | | | |
| 4.1 | Application | : | Both Indoor & outdoor | |
| 4.2 | Sheet thickness | : | 2.0 | mm |
| 4.3 | Degree of protection | | | |
| | a) Indoor | : | IP : 54 | |
| | b) Outdoor | : | IP : 55<br>(weather-proof protection with canopy) | |
| 4.4 | Type of Incomer | : | Switch-Fuse | |
| 4.5 | No. of poles for Aviation lighting panel MCBs | : | 1 / 3 | |

| | TITLE: | SPECIFICATION NO. PES-558-01A |
|---|---|---|
| | **LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL** | VOLUME - II B |
| | | SECTION - D |
| | | REV.NO. 0 DATE |
| | | SHEET 3 OF 3 |

| | | | | | |
|---|---|---|---|---|---|
| 4.6 | Type of mounting of decorative lighting panel | | : | Not applicable | |
| 4.7 | Whether decorative lighting panel required with acrylic panel | | : | Not applicable | |
| 5.0 | LABELING | | : | As per specification | |
| 6.0 | PAINTING | | : | | |
| 6.1 | Shade (as per IS:5) | | | | |
| | | | | Interior | Exterior |
| | a) | LDBs | : | Glossy white | 631 of IS:5 |
| | b) | LPs | : | -do- | -do- |
| 6.2 | FINISH | | | | |
| | a) | Interior | : | Semi-glossy | |
| | b) | Exterior | : | Semi-glossy | |
| 6.3 | Paint thickness (min.) | | : | 50 microns | |
| 7.0 | MAKE OF COMPONENTS | | : | Shall be subject to BHEL approval | |

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| | LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – B) | VOLUME II B |
| | | SECTION D |
| | | REV NO. / DATE |
| | | SHEET 1 OF 4 |

1.0 SYSTEM DESIGN DATA

1.1 Design Ambient : °C

1.2 Details of Operating parameters

a) AC Supply

i. Rated voltage : V

ii. Rated frequency : Hz

iii. Voltage variation (Permissible) : %

iv. Frequency variation (Permissible) : %

v. Combined voltage & frequency variation (sum of absolutes permissible) : %

vi. System fault level at rated voltage :

b) DC Supply

i. Rated voltage : V

ii. Voltage variation (Permissible) : %

iii. System fault level at rated voltage :

2.0 APPLICABLE STANDARDS : As per Annexure I

3.0 Lighting Distribution Boards

3.1 Sheet thickness : mm

3.2 Degree of protection

a) Main panel :

b) Transformer cubicle :

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| | LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – B) | VOLUME II B |
| | | SECTION D |
| | | REV NO. / DATE |
| | | SHEET 2 OF 4 |

| | | | |
|---|---|---|---|
| 3.3 | Type of Incomer | : | [ ] MCCB<br>[ ] Switch-Fuse |
| 3.4 | Type of Outgoing Feeders | : | [ ] Switch-Fuse<br>[ ] MCB |
| 3.5 | Bus bar material | : | [ ] Aluminium [ ] Copper |
| 3.6 | Cable entry | : | [ ] Bottom [ ] Top |
| 3.7 | Whether under voltage relay required in DC LDB | : | [ ] Yes [ ] No |
| 3.8 | Range of time delay relay | : | |
| 3.9 | Whether hinged door with locking facility provided | : | [ ] Yes [ ] No |
| 3.10 | Whether earth busbar provided | : | [ ] Yes [ ] No |
| 3.11 | Earth busbar material | : | [ ] GI [ ] Copper |
| 3.12 | Fault current and duration | : | kA |
| 3.13 | Lighting Transformer | | |
| | a) kVA Rating(s) | : | 50 100 |
| | b) Type of cooling | : | |
| | c) Rated current | | |
| | i. Primary | : | Amp. |
| | ii. Secondary | : | Amp. |
| | d) Rated voltage | | |
| | i. Primary | : | Volts |
| | ii. Secondary | : | Volts |
| | e) Rated frequency | : | Hz |
| | f) No. of phases | : | |
| | g) Temperature rise above ambient in winding by resistance | : | $^{o}C$ |

| TITLE | SPECIFICATION NO. | |
|---|---|---|
| LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – B) | VOLUME | II B |
| | SECTION | D |
| | REV NO. | DATE |
| | SHEET 3 OF 4 | |

| | | | | |
|---|---|---|---|---|
| h) | Vector Group | : | | |
| i) | Tap changer | | | |
| | i. Type | : | | |
| | ii. Range | : | | |
| | iii. No. of taps | : | | |
| | iv. Voltage of each tap | : | | |
| j) | Type of ventilation arrangement provided for transformer enclosure | : | | |
| k) | Iron loss at 50 Hz and 100% rated voltage | : | | kW |
| l) | Regulation at full load and at 75 $^{o}$C and 0.8 p.f. lagging | : | | |
| m) | Copper loss at rated load and 75 $^{o}$C | : | | kW |
| n) | Impedance at rated current, frequency and at 75 $^{o}$C | : | | |
| o) | Winding conductor material | : | | |
| p) | Whether transformer is encapsulated | : | [ ] Yes | [ ] No |
| q) | Insulation class | : | | |
| r) | Weight | : | | kg |

| | | | |
|---|---|---|---|
| 4.0 | Lighting Panel | | |
| 4.1 | Application | : | [ ] Indoor [ ] Outdoor [ ] Both |
| 4.2 | Sheet thickness | : | mm |
| 4.3 | Degree of protection | | |
| | a) Indoor | : | IP : |

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| | LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – B) | VOLUME II B |
| | | SECTION D |
| | | REV NO. / DATE |
| | | SHEET 4 OF 4 |

| | | | | |
|---|---|---|---|---|
| | b) | Outdoor | : | IP : |
| 4.4 | Type of Incomer | | : | [ ] Switch-Fuse<br>[ ] MCB |
| 4.5 | MCB type for street lighting panel. | | : | [ ] 1 pole [ ] 3 pole |
| 4.6 | Busbar material | | : | |
| 4.7 | Whether hinged door with with locking facility provided | | : | [ ] Yes [ ] No |
| 4.8 | Whether earthing studs provided | | : | [ ] Yes [ ] No |

5.0 LABELING

| | | | |
|---|---|---|---|
| | Requirement of specification complied with | : | [ ] Yes [ ] No |

6.0 PAINTING

6.1 Shade (as per IS:5)

| | | | Interior | Exterior |
|---|---|---|---|---|
| a) | LDBs | : | | |
| b) | LPs | : | | |

6.2 Finish

| | | | |
|---|---|---|---|
| a) | Interior | : | [ ] Matt [ ] Semi-glossy |
| b) | Exterior | : | [ ] Semi-glossy [ ] Full-glossy |

6.3 Paint thickness (min.) : microns

7.0 O&M SPARES

| | | | |
|---|---|---|---|
| 7.1 | Duration for which O&M spares considered | : | years |

| | TITLE | SPECIFICATION NO. | |
|---|---|---|---|
| | LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – C) | VOLUME | II B |
| | | SECTION | D |
| | | REV NO. | DATE |
| | | SHEET 1 OF 5 | |

1.0 SYSTEM DESIGN DATA

1.1 Design Ambient : °C

1.2 Details of Operating parameters

a) AC Supply

i. Rated voltage : V

ii. Rated frequency : Hz

iii. Voltage variation (Permissible) : %

iv. Frequency variation (Permissible) : %

v. Combined voltage & frequency variation (sum of absolutes permissible) : %

vi. System fault level at rated voltage :

b) DC Supply

i. Rated voltage : V

ii. Voltage variation (Permissible) : %

iii. System fault level at rated voltage :

2.0 APPLICABLE STANDARDS : As per Annexure I

3.0 LIGHTING DISTRIBUTION BOARDS

3.1 Sheet thickness : mm

3.2 Degree of protection

a) Main panel :

b) Transformer cubicle :

3.3 Type of Incomer : [ ] MCCB

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| BHEL | LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – C) | VOLUME II B<br>SECTION D<br>REV NO. DATE<br>SHEET 2 OF 5 |

[ ] Switch-Fuse

| | | | |
|---|---|---|---|
| 3.4 | Type of Outgoing Feeders | : | [ ] Switch-Fuse<br>[ ] MCB |
| 3.5 | Bus bar material | : | [ ] Aluminium [ ] Copper |
| 3.6 | Cable entry | : | [ ] Bottom [ ] Top |
| 3.7 | Whether under voltage relay required in DC LDB | : | [ ] Yes [ ] No |
| 3.8 | Range of time delay relay | : | |
| 3.9 | Whether hinged door with locking facility provided | : | [ ] Yes [ ] No |
| 3.10 | Whether earth busbar provided | : | [ ] Yes [ ] No |
| 3.11 | Earth busbar material | : | [ ] GI [ ] Copper |
| 3.12 | Fault current and duration | : | kA |
| 3.13 | Lighting Transformer | | |
| | a) kVA Rating(s) | : | 50 100 |
| | b) Type of cooling | : | |
| | c) Rated current | | |
| | i. Primary | : | Amp. |
| | ii. Secondary | : | Amp. |
| | d) Rated voltage | | |
| | i. Primary | : | Volts |
| | ii. Secondary | : | Volts |
| | e) Rated frequency | : | Hz |
| | f) No. of phases | : | |
| | g) Temperature rise above ambient in winding by resistance | : | $^{o}C$ |
| | h) Vector Group | : | |

| TITLE | SPECIFICATION NO. |
|---|---|
| LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – C) | VOLUME II B |
| | SECTION D |
| | REV NO. / DATE |
| | SHEET 3 OF 5 |

i) Tap changer

i. Type :

ii. Range :

iii. No. of taps :

iv. Voltage of each tap :

j) Type of ventilation arrangement provided for transformer enclosure :

k) Iron loss at 50 Hz and 100% rated voltage : kW

l) Regulation at full load and at 75 $^{O}$C and 0.8 p.f. lagging :

m) Copper loss at rated load and 75 $^{O}$C : kW

n) Impedance at rated current, frequency and at 75 $^{O}$C :

o) Winding conductor material :

p) Whether transformer is encapsulated : [ ] Yes [ ] No

q) Insulation class :

r) Weight : kg

4.0 LIGHTING PANEL

4.1 Application : [ ] Indoor [ ] Outdoor [ ] Both

4.2 Sheet thickness : mm

4.3 Degree of protection

a) Indoor : IP :

b) Outdoor : IP :

| TITLE | SPECIFICATION NO. |
|---|---|
| LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – C) | VOLUME II B |
| | SECTION D |
| | REV NO. / DATE |
| | SHEET 4 OF 5 |

| | | | |
|---|---|---|---|
| 4.4 | Type of Incomer | : | [ ] Switch-Fuse<br>[ ] MCB |
| 4.5 | MCB type for street lighting panel. | : | [ ] 1 pole [ ] 3 pole |
| 4.6 | Busbar material | : | |
| 4.7 | Whether hinged door with with locking facility provided | : | [ ] Yes [ ] No |
| 4.8 | Whether earthing studs provided | : | [ ] Yes [ ] No |

5.0 LABELING

Requirement of specification complied with : [ ] Yes [ ] No

6.0 PAINTING

6.1 Shade (as per IS:5)

| | | Interior | Exterior |
|---|---|---|---|
| a) | LDBs | : | |
| b) | LPs | : | |

6.2 FINISH

| | | | |
|---|---|---|---|
| a) | Interior | : | [ ] Matt [ ] Semi-glossy |
| b) | Exterior | : | [ ] Semi-glossy [ ] Full-glossy |

6.3 Paint thickness (min.) : microns

7.0 MAKE

| EQUIPMENT | MAKE | TYPE DESIGNATION OF MANUFACTURER |
|---|---|---|
| 7.1 LDBs | | |
| a) AC | | |
| b) DC | | |

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| | LIGHTING DISTRIBUTION BOARD & LIGHTING PANEL (DATA SHEET – C) | VOLUME II B |
| | | SECTION D |
| | | REV NO. / DATE |
| | | SHEET 5 OF 5 |

7.2 LPs

a) AC

b) DC

c) Decorative

d) Street Lighting

8.0 QUANTITY VARIATION (Limited to the value of the contract)

a) Till the "Engineering" is complete : %

b) Till the "Erection" is complete : %

9.0 O&M SPARES

9.1 Duration for which O&M spares considered : years

10.0 DOCUMENTATION

Whether following enclosed :

a) General Arrangement drawings of all types of LDBs : [ ] Yes [ ] No

b) General Arrangement drawing of Lighting Transformer : [ ] Yes [ ] No

c) Bar chart of activities of manufacture, testing, inspection and dispatch : [ ] Yes [ ] No

The above documents shall be submitted in the form of Annexure- A to Annexure - C in the exact order listed above along with this Data Sheet C duly filled up.

| | TITLE | SPECIFICATION NO. | |
|---|---|---|---|
| BHEL | LIGHTNING PROTECTION OF CHIMNEY (SUPPLY & INSTALLATION) | VOLUME | II B |
| | | SECTION | D |
| | DATA SHEET – C (TO BE SUBMITTED BY SUCCESSFUL BIDDER) | REV NO. | DATE |
| | | SHEET 1 OF 1 | |

1.0 Name of manufacturer :

2.0 Place & country of manufacture :

3.0 Standards applicable :

- i/ For materials & sizes :
- ii/ For galvanisation/Electroplated coating :
- iii/ For testing uniformity of Galvanization :
- iv/ For code of practice :
- v/ For temporary lightning protection during construction :

4.0 Thickness of galvanizing on steel (microns) :

5.0 Thickness of Electroplated coatings (microns) :

6.0 Thickness of Lead coating on copper (mm) :

7.0 Materials and sizes offered :

- i/ Below ground annular ring conductor :
- ii/ Electrodes :
- iii/ Below ground interconnection conductor :
- iv/ Down Conductors :
- v/ Vertical air terminations :
- vi/ Horizontal air termination :
- vii/ Test Pit :
- viii/ Earthing band ring (above landing platform) :
- ix/ Test Link :
- x/ Conductor for equipment earthing :

## ANNEXURE-I

## LIST OF APPLICABLE STANDARDS

### Illumination

| | | |
|---|---|---|
| 1. | Code of practice for interior illumination | [ ] IS 3646 [ ] |
| 2. | Code of practice for industrial lighting | [ ] IS 6665 [ ] |
| 3. | Code of practice for design of electrical street lighting installations | [ ] IS 1944 [ ] |

### Luminaires

| | | |
|---|---|---|
| 4. | General and safety requirement for electric lighting fittings | [ ] IS 1913 [ ] |
| 5. | Luminaires | [ ] IS 10322 [ ] |
| 6. | Industrial lighting fittings with metal reflector | [ ] IS 1777 [ ] |
| 7. | Industrial lighting fittings with plastic reflectors | [ ] IS 3287 [ ] |
| 8. | Decorative lighting outfits | [ ] IS 5077 [ ] |
| 9. | Water proof electric lighting fittings | [ ] IS 3528 [ ] |
| 10. | Water tight electric lighting fittings | [ ] IS 3553 [ ] |
| 11. | Dust proof electric lighting fittings | [ ] IS 4012 [ ] |
| 12. | Dust tight electric lighting fittings | [ ] IS 4013 [ ] |
| 13. | Flameproof electric ltg. fittings well glass & bulk head types | [ ] IS 2206 [ ] |
| 14. | Electric lighting fittings for division 2 areas | [ ] IS 8224 [ ] |

Lamps

| | | |
|---|---|---|
| 15. | Electric lamps, tungsten filament general service | [ ] IS 418 [ ] |
| 16. | Tubular fluorescent lamps for general lighting service | [ ] IS 2418 [ ] |
| 17. | High pressure mercury vapour lamps | [ ] IS 9900 [ ] |
| 18. | High pressure sodium vapour lamps | [ ] IS 9974 [ ] |

Luminaire Components

| | | |
|---|---|---|
| 19. | Ballast for fluorescent lamps for switch start circuits | [ ] IS 1534 [ ] |
| 20. | Ballast for high pressure mercury vapour lamps | [ ] IS 6616 [ ] |
| 21. | Capacitors for electric discharge lamps (fluorescent and MV) | [ ] IS 1569 [ ] |
| 22. | Bi-p i lamp holders for tubular fluorescent lamps | [ ] IS 3223 [ ] |
| 23. | Methods of measurment of lamp cap temp. rise | [ ] IS 8913 [ ] |
| 24. | Starters for fluorescent lamps | [ ] IS 2215 [ ] |
| 25. | Holders for starters for tubular fluorescent lamps | [ ] IS 3324 [ ] |
| 26. | Cast acrylic sheets for use in luminaires | [ ] IS 7569 [ ] |

Assembled Equipment and Components

| | | |
|---|---|---|
| 27. | General requirements for swgr. and control gear for voltage not exceeding 1000 V AC or 1200 V DC | [ ] IS 4237 [ ] |
| 28. | Code of practice for selection, installation & maintenance of switchegear & control gear | [ ] IS 10118 [ ] |
| 29. | Flame proof enclosures for electrical apparatus | [ ] IS 2148 [ ] |

| | | |
|---|---|---|
| 30. | Classification of hazardous areas for electrical installations | [ ] IS 5572<br>[ ] |
| 31. | Degree of protection provided by enclosures for LV switchgear & control gear | [ ] IS 2147<br>[ ] |
| 32. | Dry type transformers | [ ] IS 11171<br>[ ] |
| 33. | Air break switches, disconnector etc. and fuse combinations units | [ ] IS 4064<br>[ ] |
| 34. | Miniature air break circuit breaker for voltages not exceeding 1000 V | [ ] IS 8828<br>[ ] |
| 35. | Low voltage Fuses | [ ] IS 9224<br>[ ] |
| 36. | Contactors for voltags not exceeding 1000 V AC or 1200V DC | [ ] IS 2959<br>[ ] |
| 37. | Indicator lamps (visual) | [ ] IS 1901<br>[ ] |

Poles, Sockets and Other Miscellaneous

| | | |
|---|---|---|
| 38. | Tubular steel poles for over head power lines | [ ] IS 2713<br>[ ] |
| 39. | Three pin plugs and sockets | [ ] IS 1293<br>[ ] |
| 40. | Switch socket outlets (non-interlocking) | [ ] IS 4615<br>[ ] |
| 41. | Interlocking switch socket outlet | [ ] IS 4160<br>[ ] |
| 42. | Structural steel (Standard quality) | [ ] IS 226<br>[ ] |
| 43. | Danger notice plates | [ ] IS 2551<br>[ ] |
| 44. | Boxes for enclosure of electric accessories steel & cast iron boxes | [ ] IS 5133<br>[ ] |
| 45. | Code of practice for general construction in steel | [ ] IS 800<br>[ ] |

| | | |
|---|---|---|
| 46. | Wrought alumirium and aluminium alloy bars, rods, tubes and sections for electrical purposes | [ ] IS 5082<br>[ ] |
| 47. | Code of practice for phosphating of iron and steel | [ ] IS 6005<br>[ ] |
| 48. | Colour for ready mixed paints & enamels | [ ] IS 5<br>[ ] |
| 49. | Recommended practice for hot dip galvanising of iron & steel | [ ] IS 2629<br>[ ] |
| 50. | Method of testing uniformity of coating on zinc coated articles | [ ] IS 2603<br>[ ] |

# SECTION - D
# SUB-SECTION – A6

# STACK ELEVATOR

# 1. DESIGN AND CONSTRUCTION

## 1.1 Stack Elevator - General

1.1.1 The stack elevator including mechanical and electrical components shall be installed outside/inside Single flue/ multi flue chimney. Since chimney is a free standing structure, deflection of chimney top is expected during the normal operation, so the design of the elevator shall be in such a way that the elevator operation will be safe even with the expected maximum deflection of the chimney structure. The stack elevator shall lift a pay load as indicated against rated load as mentioned in Data sheet-A or its nearest as per manufacturer's present standard in addition to the weight of the car and its accessories and shall travel at a rated speed as indicated in the data sheet-A. Travel of the elevator car, number of landings and levels shall be as per Data sheet-A attached to this section.

1.1.2 Stack elevator mechanical and electrical operating devices and trailing cable shall be designed for operation indoors/out door with dusty and high humidity conditions and shall operate equally well in any ambient temperature encountered in the site conditions. Additionally, all mechanical and electrical components of the elevator shall be designed to withstand without damage a temperature of 100oC when the elevator is not operating.

1.1.3 Cage earthing shall be done through trailing cable.

1.1.4 Stack elevator shall be attached to the chimney shell using expansion type anchor bolts drilled in to chimney shell. Elevator shall be capable of operating from the ground floor to the top platform with intermediate stops at all platforms. Landing for elevator parking shall be one (1) metre above the stack ground floor. Suitable concrete/brick steps leading to the landing for entry to cabin shall also be provided,

1.1.5 The stack elevator shall be designed in line with recommendations contained in the latest editions of the applicable codes and standards.

## 1.2 Equipment Specification

1.2.1 Enclosures

i. A three-sided enclosure with one access door shall be provided at graded level. At each platform landing above graded level, a one sided enclosure with access door shall be provided. Enclosures shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high and one coat of epoxy primer coated. Enclosure access doors shall be electrically and mechanically interlocked so that they remain closed and locked except when the Cab is at the landing. Doors shall be bi-parting and swinging type.

ii. Base of three-sided enclosure shall be securely anchored to the grade level floor slab using expansion type anchors.

1.2.2 Mast

i. Mast shall be provided in sections approximately 1.52 m in lengths considering of tubular sections and/or structural shapes welded together to form a frame work to which the rack is bolted. Mast shall be securely anchored to the concrete chimney walls.

1.2.3 Cab

i. Cab frame shall be fabricated from tubular steel and enclosed with expanded metal or wire mesh.

ii. Cab floor shall be of skid resistant glass fibre reinforced plywood or approved equal. Cab shall be attached to a framed structure and form integral part with the drive mechanism located atop the cab.

Framed structure shall include guide rollers and safety hooks to ensure positive engagement of the rack and pinion to prevent cab disengagement in case of roller failure.

1.2.4 Buffers

i. Sufficient numbers of buffers of spring loaded/hydraulic type shall be fitted below the cab. The buffers shall be capable of stopping the cab without permanent damage or deformation to themselves or any other part of the equipment. The number of buffers shall be so fixed as to ensure proper sharing of impact loads by all of them.

1.2.5 Drive unit and safety Device

i. Drive unit located on the top of the cab shall be complete with Ac squirrel cage induction motor, reduction gear, drive pinion and an over speed governor. Drive unit shall incorporate an electric disc brake and an external manual brake release. The brake on the electric motor will be of the electromagnetic single disc self-adjusting type with the mechanical compression spring being held off by the electromagnet.

ii. The hoist shall be provided with a centrifugal brake to prevent accidental tripping of safety device when the cage shall be taken to the ground by gravity in case of power failure.

1.2.6 Power and Control

i. All electrical components furnished with the elevator shall be completely wired, energised and checked. Necessary power distribution arrangement shall be provided by the contractor to feed the electrical power to the elevator.

ii. All electrical control devices shall be in enclosures. Equipment furnished shall also include the following:

a) Momentary contact push button for raise lower control.

b) Reversing combination motor starter with a moulded case circuit breaker for the motor. Starter shall be equipped with three thermal overload relays for motor protection. Operating handle for the combination starter circuit breaker shall be accessible from inside the cab and shall also serve as an emergency stop switch.

c) Electrical and mechanical interlocks on cab access door and landing level enclosure doors.

d) Over travel protection, emergency stop push button, over speed governors.

e) All electrical and mechanical interlocks on cab access door and landing level enclosure doors, phase reversal protection shall be provided.

f) An alarm push button shall be provided in the cage connected to a battery-operated alarm at the elevator base. Simultaneous alarm shall also sound at the plant control room in the event of any fault in the stack elevator for which one potential free contact shall be provided in each elevator for audiovisual alarm in PCR for “Stack Elevator fault” indication.

g) Reverse phase relay connected to prevent operation of the cab with improper phase rotation or failure in any phase in the power supply.

h) Continuous duty electric torque motor recoil cable reels as required to maintain electrical power service to all elevator electrical components throughout the limits of travel.

i) One auxiliary panel shall be furnished and mounted on the grade level enclosure. Panel shall be equipped with a main 'ON-OFF' isolating switch, main contactor, relays, control transformer and fuses, tone frequency transfer, terminal blocks and all other accessories required for normal operation of the elevator.

j) One main control panel shall be furnished and mounted on the top of the cab. Panel shall be equipped with necessary, equipped like rectifier, battery, charger, tone frequency receiver, contactors, MCBs, control transformer and fuses, thermal overload relays, and all other equipment and accessories required for normal operation of the elevator.

k) Control cabinets shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be cold rolled and at least 2.0 mm thick and properly braced to prevent wobbling. Degree of protection of the control cabinets shall be IP-52 as per IS:2147. Control cabinets shall be provided with hinged door(s) with padlocking arrangement. All doors, removable covers and plates shall be gasket all around with neoprene gaskets, louvers, when provided, shall have screeners and filters. The screens shall be of fine wire mesh made of brass or GI wire. Suitable cable gland plate shall be supplied fitted on to this gland plate. All cable glands shall be screwed on type and made of brass.

l) Each motor to be controlled from the control cabinet shall be provided with 3 pole isolating switch. HRC fuses, contactors of AC4 duty class with thermal overload relays with single phasing preventer and other equipment required for satisfactory control motor. The isolating switch and contractor shall be rated at least 20% more than the connected motor full load current. Motors of 0.2 KW and above shall be rated for 415 V 3 Phase and below 0.2 KW will be 240 V single phase supply.

m) The controllers and resistors for motors shall conform to IS-8544 (latest edition) and IS-2959 (latest edition) and shall be continuously rated for 150% full load current of the motor. Switches shall be hand operated, air breaker heavy duty, quick make, quick break type conforming to IS-4064. The rating of switch shall be so chosen as to get complete protection by associated O/L relay or fuse under all normal / abnormal conditions such as full load, overload, locked rotor, short circuit. The incoming power supply isolating switch shall be inter-locked with the control cabinet door so as to prevent opening of the door when the switch is closed. Device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.

n) All fuses shall be of the HRC cartridge type mounted on plug in type of fuse base having a prospective current rating of not less than 80 KA. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded and it shall be possible to change fuses with the circuit alive without danger of contact with live metal.

o) Contractor shall provide dry type transformers with class B insulation for control power supply, lighting and space heating. Control supply will be 240 V AC.

Transformer for control supply shall be provided with a control tap at 110 V, which will be earthed. Power and control supply to individual drives and users shall be distributed with separate isolating switches and primary and secondary fuses.

p) All push buttons shall be of push to actuate type having 2 “NO” and 2 “NC” self reset contacts. They shall be provided with integral escutcheon on plate engraved with their functions. Push button contacts shall be rated for 5 Amp at 415 V AC and 1 Amp. Inductive breaking at 250 V, DC. Mushroom type emergency push button to open the main contactor shall be provided in the operator’s cabin and two on the bridge platform within easy reach indicating lamps shall be of the filament type and low watt consumption lamps shall be provided with series resistors.

q) Strip type space heaters of adequate capacity shall be provided inside in each cabinet.

r) Control cabinets shall be supplied completely wired. All wiring shall be carried out with 650 V grade PVC insulated, stranded conductors. Power circuits shall be wired with stranded aluminum conductors of adequate sizes to suit the rated circuit shall be wired with stranded copper conductors of sizes not small than 1.5 Sq.mm. Control circuits shall be isolated from power circuits.

s) Cab shall be controlled by a semi-automatic floor selection control system. Cab shall be furnished with 240 Volt grounding type receptacle, emergency alarm push button with a normally open contact rated 0.5 ampere at 220 VDC volts, indicating light, limit switches, and all other necessary control devices required to ensure safe and continuous cab operation. One trailing cable shall connect the cab main control panel to the auxiliary panel at ground level. Cable shall supply the cab with all power requirements. Cable guides shall be installed at every 6 metres to avoid entanglement of this cable. Control signals between the auxiliary panel at ground level and the main control panel on the cab. Will be provided with the tone frequency receiver. However control and interlocks from the landings shall be connected to the auxiliary panels located at ground level through fixed armoured cables. The power and control cables and training power cables shall be FRLS type.

t) Each landing assembly shall include a limit switch for door interlock and push button control station installed and wired to a landing junction box.

u) Cable trolley with cable guides for recoil of cable on to cable reel to maintain electrical power service to all elevator components through out the limits of travel.

v) Contractor shall furnish, install, and connect a system equipment ground to the Owner’s existing chimney ground system. System equipment ground shall electrically connect panels and junction boxes, which contain electrical devices, motors, and elevator platforms and support structure. Raceway system shall not be considered as an equipment ground.

w) All enclosures containing electrical devices shall be provided with 240 Volt, single-phase space heaters with adjustable thermostat control.

x) All power cables and race way shall be furnished and installed by the Contractor for interconnection of the main control panel, auxiliary panel and landing junction boxes etc. Conductors included in the cable shall be as required to energise all electrical equipment furnished with the elevator. Transmission of

alarm signals is done by means of tone frequency equipment. Hence communication conductors are not required.

1.2.7 Electric Motor

i. Elevator drive motor shall be squirrel-cage induction type designed and fabricated to conform to the requirements indicated below.

ii. Motor shall be designed for operation at the required speed: 415 Volts, 3 phase, 50 hertz. And shall be suitable for full voltage starting, S4 duty class as per IS-4722 with CDF of 25% and maximum number of 120 starts per hour in 55 Deg. C ambient temperature. Motor shall be tested at the factory to determine that it is free from electrical or mechanical defects.

1.2.8 Raceway

i. General

a) Complete raceway system for the elevator shall be furnished and installed in accordance with this section and the Contractor's shop drawings as reviewed and accepted by the Engineer-in-Charge. The Contractor shall provide drawings for acceptance showing the routing of conduit and wiring for the control circuits associated with the elevator.

b) Raceway system is defined to include conduit and all related materials and devices required to support, secure and provide a complete system for support and protection of electrical cable and wiring.

ii. Materials

a) Raceway shall be rigid galvanized steel conduit, provided in accordance with IS-1653 (latest edition).

b) Steel conduit, couplings, and elbows shall be hot-dip galvanized rigid mild steel. Each length of threaded conduit shall be complete with a coupling on one end and a thread protector on the other. Thread protector shall have sufficient mechanical strength to protect the threads during normal handling and storage. Flexible conduits shall be plastic jacketed, liquid tight galvanized steel.

c) Galvanized iron or galvanized cast steel fittings shall be used with galvanized steel conduit. Fittings installed outdoors or in damp locations shall be sealed and gasketted. Outdoor fittings shall be of heavy cast construction.

1.2.9 PVC Insulated FRLS Cable

i. Materials

a) Electrical part of this specification shall be referred for FRLS cable. Unless specified otherwise, Contractor shall submit to the Engineer-in-Charge four copies of the manufacturer's test report on each cable furnished. Conductor accessories including terminal materials like glands, lugs etc. makers, tying materials and cable support shall be furnished and installed. Wire termination materials for conductors 10 Sq. mm and larger shall be pressure or bolted type. Terminals for conductors smaller than 10 Sq. mm shall be an insulated pressure connection in the shape of a ring.

ii. Installation

a) Power and control cable shall be routed as required by the drawings. Cables pulled into the wrong conduit or cut too short shall be replaced. Cables removed from one conduit shall not be installed in another conduit.

1.2.10 Earthing

i. General

a) Earthing system furnished and installed and include a complete earthing system for the elevator. Earthing equipment and materials shall be furnished and installed in accordance with the reference codes and standards these specifications and the contractor's shop drawings as reviewed and accepted by the Engineer-in-Charge.

ii. Materials

a) The earthing of all electrical items being supplied by the Bidder shall be in his scope. For earthing the various equipment, conductor sizes shall be as listed below:

- MCCs Motor above 90 KW : 50 x 6 Sq.mm G.I. flat
- Motors above 30 KW, upto 75 KW and lighting panel/ control panels/auxiliary panels : 25 x 6 Sq. mm G.I. flat
- Motor above 5 KW upto 30 KW : 25 x 3 mm G.I. flat
- Motors upto 5 KW and misc. : 8 SWG GI wire
- Small item like conduits,
- Junction boxes etc..

# SUB-SECTION-VII

# MANDATORY SPARES

| CLAUSE NO. | MANDATORY SPARES |
|---|---|

1.00.00 **GENERAL**

The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and Recommended spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:

1.01.00 **MANDATORY SPARES**

a) The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.

b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by **) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as 'set' (marked by*) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings.

c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly.

d) The Employer reserves the right to buy any or all the mandatory spare parts.

e) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.

f) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.

g) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.

1.02.00 **RECOMMENDED SPARES**

a) In addition to the spare parts mentioned above, the Contractor shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Forms & Price Schedules. This list shall take into consideration the mandatory spares specified in this Sub-Section and should be independent of the list of the mandatory spares. The Employer reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment.

b) Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.

1.03.00 **START-UP & COMMISSIONING SPARES**

a) Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the Plant is handed over to the Employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.

1.04.00 The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:

| CLAUSE NO. | MANDATORY SPARES |
|---|---|
| 2.00.00 | The Contractor shall indicate the service expectancy period for the spare parts (both mandatory and recommended) under normal operating conditions before replacement is necessary. |
| 3.00.00 | All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccators packs as necessary. |
| 4.00.00 | All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan. |
| 5.00.00 | The Contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares. |
| 6.00.00 | Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification. |
| 7.00.00 | All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer. |
| 8.00.00 | The Contractor will provide the Employer with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/components/ equipments covered under the Contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors. |
| 9.00.00 | The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship. |
| 10.00.00 | In addition to the recommended spares listed by the Contractor, if the Employer further identifies certain particular items of spares, the Contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires. |
| 11.00.00 | The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall |

guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Sub-Contractors, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items.

| CLAUSE NO. | MANDATORY SPARES | |
|---|---|---|
| 1.27.00 | **MANDATORY SPARES FOR CHIMNEY ELEVATOR (Qty. indicated are for one (1) No. Chimney Elevator)** | |
| A. | BRAKE | ASSEMBLY Qty. |
| | 1. Brake Assembly complete | 1 No. |
| B. | GEAR ASSEMBLY | |
| | 2. Gear Assembly complete | 1 No. |
| C. | DOOR FRONT | |
| | 3. Bearing | 3 Nos. |
| | 4. Roller | 3 Nos. |
| | 5. Bushing (if applicable) | 2 Nos. |
| D. | LIMIT CAMS | |
| | 6. Sensor | 3 Nos. |
| | 7. Switch arm | 3 Nos. |
| E. | CAB | |
| | 8. Guide roller | 100% of the total ones installed each type or min. 1 no. whichever is higher |
| | 9. Switch | 3 Nos. |
| F. | SLIDING DOOR | |
| | 10. Rollers (if applicable) | 4 Nos. each type |
| G. | MACHINERY | |
| | 11. Guide roller | 2 Nos. |
| | 12. Pinion | 2 Nos. |

| | | | |
|---|---|---|---|
| | 13. | Rubber inserts (if applicable) | 12 Nos. |
| | 14. | Groove ring (if applicable) | 6 Nos. |
| | 15. | Brake motor | 1 No. |
| H. | CABLE TROLLEY BEARING (if applicable) | | |
| | 16. | Bearing | 3 Nos. of each type |
| I. | ELECTRICAL EQUIPMENTS | | |
| | 17. | Contactors | 1 No. of each type |
| | 18. | Auxiliary transformer | 1 No. |
| | 19. | Relays | 1 No. of each type & rating |
| | 20. | Switch | 2 Nos. each type |
| | 21. | Rectifier | 3 Nos. |
| | 22. | Limit switch | 3 Nos. each type |
| | 23. | Transmitter (if applicable) | 1 No. if applicable |
| | 24. | Receiver (if applicable) | 1 No. if applicable |
| | 25. | Battery charger | 1 No. |
| | 26. | Push Buttons | 3 Nos. of each type |
| | 27. | Timers | 2 Nos. of each type & rating |
| | 28. | Main drive motor with control system | 1 Set |

# SUB-SECTION - A6

# STACK ELEVATORS

1.01.00 **ELEVATOR PARTICULARS**

i) Load Carrying Capacity in Kg
ii) Type of loading for which the stack elevator is designed
iii) Type of stack elevator
iv) Rated Load in Kg
v) Speed in metre/minute
vi) Chimney height in metre
vii) Total travel height in metre
viii) No. of floors to be served
ix) Elevations of the floors to be served
x) Method of control
xi) Details of indicators and control
xii) Weight of cab complete without load in Kg
xiii) Weight of hoist cab in Kg
xiv) Efficiency of Elevator

1.02.00 GROUND ENCLOSURE

i) Size of the enclosure (Length x breadth x height)
ii) Material of construction
iii) Size of landing entrance
iv) Method of door operation
v) Electrical & mechanical interlocking Of the door provided.
vi) Method of fixing enclosure to chimney
vii) Any other details not covered above

1.03.00 LANDING ENCLOSURES

viii) Size of the enclosure (Length x breadth x height)

ix) Material of construction
x) Size of landing entrance
xi) Method of door operation
xii) Electrical & mechanical interlocking
Of the door provided.
xiii) Method of fixing enclosure
xiv) Any other details not covered above

1.04.00 MAST
i) Material of mast
ii) Section of mast
iii) Size of each piece of mast
iv) Method of fixing of mast
v) Type of mast

1.05.0 CAB
i) Internal size
(Length x breadth x height)
ii) Material of construction
iii) Type of floor
iv) Size of the cab door
v) Method of operation of cab door
vi) Electrical & mechanical interlocking provided
vii) Escape hatch, electrically interlocked
viii) Guide roller and safety hooks provided
ix) Arrangement of light/fan inside the cab.
x) Indicators & controls inside the cab.

1.06.00 ELEVATOR DRIVE UNIT
i) Location of drive unit
ii) Name of components of drive unit

1.07.00 DETAILS OF ELECTRIC MOTOR

i) Manufacturer
ii) Equipment driven by motor
iii) Type
iv) Frame size, type & designation
v) Maximum load considered for
Sizing of motor
vi) Margin considered for sizing motor
vii) Rated power in KW
viii) Service factor
ix) Speed in rpm
x) Rated voltage in V
xi) Current at rated voltage
- Full load
- Locked rotor

xii) Insulation class
xiii) Type of bearing and type of lubricant
xiv) Space heater rating
xv) Duration considered for specified
Ambient temperature
xvi) Applicable standard to which motor conforms
xvii) Degree of protection
xviii) Efficiency at rated output
xix) Power factor
xx) Type of mounting

1.08.00 DETAILS OF REDUCTION GEAR

i) Make
ii) Material of the gears and hardness in BHN
iii) Type of gear
iv) Gear ratio

v) Gear power transmitted

vi) Input and output speed

1.09.0 DETAILS OF DRIVE AND PINION

i) Material

ii) Hardness

iii) Fixing arrangement

1.10.0 DETAILS OF RACK

i) Material

ii) Hardness

iii) Fixing arrangement

1.11.00 SAFETY DEVICE

i) Make

ii) Type of safety device

iii) Speed at which the safety device
Come into action

iv) Method operation

v) Other details

vi) Remote control for testing
The safety device

1.12.00 BRAKES

i) Manufacturer

ii) Types of brakes provided

iii) Method of operation

iv) Interlocking if any

v) Electromagnetic brake and external
Manual brake release

vi) Degree of protection

1.13.00 CENTRIFUGAL BRAKE

i) Make

ii) Details

iii) Remote control for testing
The safety device provided.

iv) Any other details of drive unit
Not covered above.

1.14.00 BUFFERS

i) No. and location of the buffers provided

ii) Type of buffers

iii) If the buffers are spring type
Furnish the following:

- Diameter of the spring in mm
- Max. Compression under extreme cond.
- No. of spring coil
- Sectional dimension
- Material of spring
- Compression /unit load

1.15.00 POWER CABLES Fixed Trailing

i) Manufacturer

ii) Type and material

iii) Rated voltage

iv) Rated current

v) Type of insulation

vi) No. of strands

vii) No. of cores

viii) Short circuit current rating

ix) Resistance per 1000 metres

x) Applicable standards

1.16.00 CONTROL CABLES

xi) Manufacturer
xii) Type and material
xiii) Rated voltage
xiv) Rated current
xv) Type of insulation
xvi) No. of strands
xvii) No. of cores
xviii) Short circuit current rating
xix) Resistance per 1000 metres
xx) Applicable standards

1.17.00 CONDUITS/ACCESSORIES AND FITTINGS

i) Material
ii) Manufacturer
iii) Applicable standard

1.18.00 CONTACTORS

i) Make
ii) Type
iii) Applicable standards
iv) No. of poles
v) Rated voltage
vi) Rated frequency
vii) Rated current
viii) Closing coil
- Rated voltage
- Current consumption

- Power consumption in KW
- Insulation class for electromagnet

ix) Rated duty
- Rated insulation category
- No. of operations per hour
- Rated breaking capacity
- Rated making capacity
- Short time rating in sec

ix) Limits of operation
- Supply voltage variations (%)
- Supply frequency variations (%)
- Drop out voltage (%)
- Min. pick up voltage (%)

x) Thermal overload relay setting range available

xi) Auxiliary contacts
- Numbers
- Current rating (Make and break)

xi) Rated utilization category as per IS 2459

xii) Max. recommended back up HRC fuse size

1.19.00 FUSES

i) Make

ii) Type

iii) Continuous current

iv) Rated voltage

v) Rated frequency

vi) Rupturing capacity

vii) Mounting details

viii) Fixing and removing arrangement

ix) Visual indication for fuses

x) Applicable standards

1.20.00 INDICATING LAMPS

i) Make
ii) Type
iii) Rated voltage
iv) Rated power consumption in Watt
v) Permissible voltage variation
vi) Series resistance provided

1.21.00 PUSH BUTTONS

i) Make
ii) Type
iii) Rating
- Voltage
- Continuous current

iv) No. of aux. Contacts
- Normally open
- Normally closed

v) Contact rating
vi) Colours
vii) Mounting arrangement

1.22.00 OVER TRAVEL LIMIT SWITCH

i) Make
ii) Type
iii) Material of contacts
iv) Contact rating
v) Numbers furnished

1.23.00 CONTROL TRANSFORMER

i) Make
ii) Type
iii) Output rating (VA)
iv) Ratio

v) Class of insulation

vi) Max. temp rise of winding over
Specified ambient temperature.

vii) One minute power frequency test voltage

viii) Applicable standards

1.24.00 CIRCUIT BREAKER AND ISOLATOR

i) Make

ii) Type

iii) Current rating in amps

iv) Interruption duty

v) Max. breaking capacity

vi) Operating voltage of tripping and closing coils

vii) Max. permissible variation of operating voltage

1.25.00 RACEWAY

i) Raceway as per specification

ii) Material of

- Indoor fittings
- Outdoor fittings
- Raceway support
- Junction boxes

1.26.0 EARTHING

i) Earthing conductor

- Size
- Material

ii) Material of earthing cable

iii) Clamps. Bolts, washers, nuts and another
Hardware of iron steel are galvanized.

1.27.00 MOTOR STARTER

i) Make & Size

ii) Rating]

iii) Mechanically latched type

iv) Single phase prevention feature provided

v) Degree of protection

1.28.00 DETAILS OF CONTROL PANELS

i) No. of panels

ii) Type of enclosures (Degree of protection)

iii) Thickness of sheet metal

iv) Painting

- Colour
- Finish

v) Cable entry

vi) Manufacturer

**TENDER NO: PSER:SCT:NBN-C2067:20**

**VOLUME -III**

**PRICE SCHEDULE-REV-00**

**FOR**

CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.


**BHARAT HEAVY ELECTRICALS LIMITED**

**( A GOVT. OF INDIA UNDERTAKING )**

**POWER SECTOR – EASTERN REGION**

**PLOT NO. – 9 / 1, DJ – BLOCK,**

**SECTOR – II, KARUNAMOYEE,**

**SALT LAKE CITY,**

**KOLKATA – 700091.**

**VOLUME-III**
**PRICE SCHEDULE, REV-00**

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**TENDER NO. PSER:SCT:NBN-C2067:20**

**PREAMBLE**

| SL NO | DESCRIPTION |
|---|---|
| 1 | This preamble forms part of tender document and schedule of items. The tenderer should read this preamble carefully before filling in rates for various items. Clauses under this preamble shall be read in conjunction with various volumes of tender and other tender sections as applicable and shall have precedence over any contrary statement mentioned any where in this document. The tenderer shall sign & stamp all the pages of the tender document as a token of their acceptance.Submission of unfilled formats with sign & stamp shall be construed as acceptance of the contents of the same. |
| 2 | The work shall be carried out strictly as per specifications, description of the items in these schedule and / or engineer's instructions. Drawings enclosd with the tender are only preliminary and for guidence/tender purposes giving some idea of the work involved. The work is to be executed as per terms & conditions of the tender and actual drawings/documents, which shall be furnished during execution. |
| 3 | Items of work provided in this schedule but not covered in this specification shall be executed strictly as per instruction of the engineer. |
| 4 | Unless specifically mentioned otherwise in the tender document, the tenderer shall quote for the finished items and shall provide for the complete cost towards power, fuel, tools, tackles, equipment, constructional plants, temporary works, labour, dismantling of all temporary piping, structures, valves, pumps, tanks & other misc. equipment, strengthening of roads/culverts/bridges etc. including arranging all clearances etc. required for carrying out differen activities & tests, materials, levies, transport, layout, repairs, rectification, maintenance till handing over, supervisions, colonies, shops, establishments, overheads, profits and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work according to the complete tender document and this schedule. |
| 5 | The quantities of the various items mentioned in this schedule of items are approximate, based on very preliminary information and may vary to any extent or be deleted altogether. The quoted rates of each item will remain firm throughout the period of execution including extension, for reasons whatsoever, as long as variation in the total value of work executed under any part of this contract including extra items, if any but excluding any price variation remains, within plus minus fifteen percent (± 15%) of the awarded price as per LOI. |
| 6 | Prior written approval of BHEL shall be sought by the contractor in case quantity variation of any item crosses +50% (plus fifty percent) limit during execution and approval to be obtained before execution of further quantity for this item. |
| 7 | In case Sealed /Paper Price Bids are opened for finalisation of the tender, for any Item Rate/BOQ based service contract, possibility of variation of quantity/ addition/deletion of items can not be ruled out. Under such circumstances, after execution of work, if it is observed that standing as L-1 is changed based on actual quantity executed, the bidder shall give suitable rebate to maintain your standing as L-1. Since this aspect can be assessed at the end of execution, necessary adjustment will be effected at the end of execution in final bill.This condition shall not be applicable where the tender is finalised through Reverse Auction. |
| 8 | BHEL reserve the right to rationalize the rates, quoted by L-1 bidder against unit rate items and/ or other optional items with respect to item-wise lowest rates (amongst the participating bidders), before placement of order. The rates of unit rate/optional items shall remain valid till execution of the order, if the job/work is awarded to the bidder. |
| 9 | The rates quoted shall be inclusive of cleaning of site of any vegetation, dressing, clearing of old structures and leveling etc. including fixing of grid pillars, benchmarks etc. required for commencement of site activities. No separate payment will be made towards the same.However, if separate rate for such item is avalable in the rate schedule, the same shall be considered. |
| 10 | Rates shall be quoted in figures and in words in clear legible writing. No overwriting is allowed. All scoring and cancellations should be countersigned and in case of illegibility the interpretation of engineer shall be final. All entries shall be in English language. |
| 11 | All works item wise shall be measured upon completion and paid for at the rates quoted and accepted as per BHEL approved payment schedule/billing break-up. |
| 12 | The tender shall be deemed to have visited site and made himself aware of all the site conditions, studied the specifications and details of work to the done within the time schedule attached and to have acquainted himself of the conditions prevailing at site before submission of his bid/offer. No claim whatsoever due to lack of knowledge of site conditions shall be entertained after award of the work. |
| 13 | No splitting of the job is envisaged unless the same is specifically indicated in the TCC/Vol-1F. Decision of BHEL in this regard shall be final and binding to the bidders. |
| 14 | Bidders are not allowed to alter the Price Schedule format including item description,quantity etc. and the offer is liable for rejection if the bidders submit their prices in Price Schedules modified by them.BHEL reserves the right to reject the offers of bidders who submit offers in Price Formats which are modiified/altered by them. Also putting any comments instead of rates/price in the designated column of the rate schedule shall make the offer liable for rejection. |
| 15 | Bidders to note that for Civil &/Structural packages, against a particular item against a ST No. appearing in more than one schedule of the BOQ, same rate must be quoted in all schedules for that particular items with same descriptions. If by error, different rates are quoted in different schedules for same ST No.(i.e. item with same description), then the higher of the rates shall be considered for evaluation but awarding shall be done with the lower rate, if the bidder becomes L-1. The same modality shall be applicable for other item rate sevice contracts where item with same decription is repeated in different schedules. |
| 16 | For Lumpsum Service Contract : The items/components indicated in the tender is indicative and may vary to any extent. No compensation shall be payable in case of any variation in the items/components listed in the bill of quantities if the executed weight remains within the variation limit. However, in case of deletion of any item or addition of new items over and above the items listed or variation of existing quantity beyond variation limit specified, adjustment (i.e. Payment or recovery as the case may be ) shall be done on pro-rata basis based on the Rate per MT worked out from the quoted lump-sum Price and the total weight of components listed /indicated in price schedule plus 15% weight variation limit. |
| 17 | Engineer's decision shall be final and binding on the contractor regarding clarification of items in the schedule with respect to the other sections/volumes of the contract. |
| 18 | In case of tender for Civil and/or Structural works, if the Non-schedule items are not quoted by the bidder, it will be treated at par with rate of corresponding item of CPWD/PWD/DSR schedule as prescribed in the tender/BOQ cum Rate Schedule. PVC/escalation is not payable for these Non-scheduled items. |
| 19 | No interest, whatsoever, shall be payable by BHEL on the security deposit, any bank guarantee submitted or any amount due to successful bidder/contractor. No idling charge whatsoever (either for labour or any other resources) is payable by BHEL for any reason whatsoever. |
| 20 | Size and weights of various items are mentioned in the attached BOQ cum rate/price schedule for reference purpose only & these shall not be taken into consideration for quoting/calculating amount in the rate schedule. These shall be utilised as per relevant sections of tender. Bidders shall quote for each item in the rate column, taking unit as mentioned in the quantity column. Rates shall be filled in both figures and words. Amount shall be calculated based upon these rates multiplied by the mentioned quantity for the respective items. |
| 21 | Bidder's Total price shall be considered for evaluation unless stated otherwise. |
| 22 | In case of BOP packages, if Bidder does not quote/indicate the price for freight chagses against indicated rate schedule, the same shall be considered as 2% of basic price and adjusted with the total quoated price against each item keeping the total quoted price unaltered. |

| VOLUME-III<br>PRICE SCHEDULE, REV-00 | | | |
|---|---|---|---|
| **JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.** | | | |
| **TENDER NO. PSER:SCT:NBN-C2067:20** | | | |
| **SCHEDULE - 1 : TOTAL PRICE** | | | |
| **SL NO** | **DESCRIPTION** | **PRICE SCHEDULE REF** | **TOTAL PRICE (IN INR)** |
| 1.0 | TOTAL PRICE FOR CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AT 4X250 MW BRBCL NABINAGAR STPP FGD, BIHAR (EXCLUDING PILE) | **SCH 2 - PRICE BREAK UP** | ***IN FIGURES:-***<br><br>***IN WORDS:-*** |
| 2.0 | NON-SCHEDULE ITEM<br>For items not covered in Schedule 2, quote % above or % below or at par of the CPWD Schedule of rates 2018 | | |
| a) | Rate of complete item | _____% above /_____% below/ at par of CPWD Rate Schedule 2018 | |
| b) | Rate of supply of material at site only | _____% above /_____% below/ at par of CPWD Rate Schedule 2018 | |
| c) | Rate for execution complete excluding supply of material | _____% above /_____% below/ at par of CPWD Rate Schedule 2018 | |
| **NOTE** | | | |
| 1.0 | Bidder shall quote total price for SCH-2- Part only at Sl No. 1 above. All other amounts / rates of each item of works in respective schedules / parts will be derived based on allocated percentages. As such, any uncalled figure/ amount noted at any other place / schedule of Volume-III will not be recknoed & will stand null & void. | | |
| 2.0 | Bidder to note that total price at Sl No. 1 above shall be considered for evaluation & awarding. As such grand total price should be complete in all respect for the full scope defined and considering all terms and conditions. | | |
| 3.0 | Bidder's quoted total price of SCH-2 at Sl. No 1 above, shall be apportioned into amount of various items of works based on allocated percentages against respective item, in respective schedules / parts. As such, bidder shall not indicate / quote any amount / rate in these schedules / parts and any amount / rate quoted against any item shall not be taken into cognizance / account and offer may be liable for rejection. | | |
| 4.0 | Based on the itemwise percentage allocations, the amount for the individual items of the Bill of Quantity shall be arrived at. The rates of individual items shall be derived from the amount against each items and its quantity after rounding off to upto 2 decimal places. However, RA bill payment shall be done after rounding off the gross amount to two decimal points. Any adjustment, if required, due to such methodology, will be effected / adjusted in final bill. | | |
| 5.0 | Bidders to note that this is an item rate contract. Payment shall be made for the actual quantities of work executed at the unit rate arrived at as per Sl No.4 above. | | |
| 6.0 | Any item as per scope of work, if not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection. | | |
| 7.0 | Price format shall not be changed by bidder in any case and it may lead to cancellation of their offer. | | |
| 8.0 | The quoted price shall be excluding GST including freight on FOR site basis. | | |
| 9.0 | The quantity of items may vary during execution mainly due to actual requirement etc. The unit rates work out from the overall amount quoted & accepted by BHEL shall be considered and no separate unit rates shall be allowed. Unit rates shall be valid throughout the contract period. | | |
| 10.0 | For payment of non schedule items, the rate shall be derived from CPWD Schedule - 2018. | | |

| VOLUME-III<br>PRICE SCHEDULE, REV-00 | | | |
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| **JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.** | | | |
| **TENDER NO. PSER:SCT:NBN-C2067:20** | | | |
| **SCHEDULE - 2 : BREAK UP OF TOTAL PRICE** | | | |
| **SL NO** | **DESCRIPTION** | **PRICE SCHEDULE REF** | **WEIGHTAGE** |
| **1.0** | TOTAL PRICE FOR CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AT 4X250 MW BRBCL NABINAGAR STPP FGD, BIHAR (EXCLUDING PILE) | | |
| **a** | SERVICE (Part -1) | SCH 3 | 0.761982790 |
| **b** | SUPPLY (Part - 2) | SCH 4 | 0.238017210 |
| **2.0** | **TOTAL** | | **1.00000000** |

| VOLUME-III<br>PRICE SCHEDULE, REV-00 | | | | | |
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| JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. | | | | | |
| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 3 - SERVICE (Part-1) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| **Part-1A** | **CIVIL WORKS** | | | | |
| 1 | Earth work in excavation in all types of soil including ash which can be excavated by any means including setting out, levelling, dewatering (but excluding special type of dewatering viz. well point method), shoring & strutting wherever required (but excluding Steel sheet piling), dressing the sides & bottom, all lifts, ramming/compacting the excavated bottom, stacking, disposal of surplus excavated materials within a lead up to 1 km, spreading/levelling of disposed materials etc all complete for following depths below ground level. **[Measurement of excavation shall be paid as per actual quantity at site as per direction of Engineer in charge)** | | | | |
| a | Depth from ground level but not exceeding 2 m | cum | 2550 | 10200 | 0.00198255 |
| b | Depth exceeding 2 m but not exceeding 4 m | cum | 2150 | 8600 | 0.00209321 |
| c | Depth exceeding 4 m but not exceeding 6 m | cum | 500 | 2000 | 0.00060937 |
| 3 | Breaking pile head up to cut off level and exposing pile reinforcement for embedment in pile cap etc including all material, labour, incidental etc. and transportation of concrete debries up to disposal yard complete as per specification, drawing and as directed by the engineer-in-charge for the following. | | | | |
| | Pile with 760 mm diameter | EACH | 155 | 620 | 0.00212896 |
| 7 | Back filling upto any depth below ground level around foundations, plinths, trenches, drains etc to proper grade and level in layers not exceeding 300 mm compacted thickness using/with selected materials directly from excavation and compacted as specified including watering, ramming/compaction by manual/mechanical means, dressing etc all complete for the following including necessary men/women, materials, equipment, loading, transportation, unloading etc as per specification, drawing and as directed by engineer- in-charge. **[Measurement of Backfilling shall be paid as per excavation quantity after deduction for concrete & other buried items etc.]** | | | | |
| b | Each layer compacted so as to achieve at least 90% maximum dry density as per IS-2720 (Part-VII) | cum | 2900 | 11600 | 0.00170623 |
| 8 | Back filling upto any depth below ground level around foundations, plinths, trenches, drains etc to proper grade and level in layers not exceeding 300 mm compacted thickness using/with approved borrowed soil (borrowed soil to be arranged by the bidder) and compacted as specified including supplying borrowed soil, royalty (if any), watering, ramming/compaction by manual/mechanical means, dressing etc all complete for the following including necessary men/women, materials, equipment, loading, transportation, unloading etc as per specification, drawing and as directed by engineer- in-charge. **[Measurement of Backfilling shall be paid as per excavation quantity after deduction for concrete & other buried items etc.]** | | | | |
| b | Each layer compacted so as to achieve at least 90% maximum dry density as per IS-2720 (Part-VII) | cum | 200 | 800 | 0.00010299 |
| 9 | Extra over item No. 1 and 3 to 7 for carriage of excavated earth/selected materials for every 500 m or part thereof beyond an initial lead of 1 km. | cum | 2200 | 8800 | 0.00031712 |
| 11 | Supplying and filling sand upto any depth below grade slab, around foundations, etc. in layers not exceeding 300 mm compacted thickness and compacted so as to achieve at least 80% relative density as per IS-2720 (Part-XIV) including spreading, watering, ramming/compaction by manual / mechanical means, dressing, royalty (if any) etc. all complete including necessary men/women, materials, equipment, loading, transportation, unloading etc as per specification, drawing and as directed by engineer- in-charge. | cum | 550 | 2200 | 0.00984269 |
| 12 | Supplying and laying (inside chimney in the space below the grade level slab) crushed rock range 63 mm to 45 mm in layers not exceeding 200 mm in thickness including breaking of stone boulders to required sizes, filling the interstices with selected sand and compacting to 85 % of original volume of stone stack for all lifts etc. all complete. Payment shall be made for the measurement of the volume of the compacted fill. | cum | 200 | 800 | 0.00392968 |
| 13 | Transportation from battching plant & laying Nominal Mix plain cement concrete (M 7.5) with graded aggregate (with maximum size of coarse aggregate not exceeding 40 mm) at all levels for all kinds of work like mass concrete, lean concrete, mudmat, filling etc. including labour, materials, equipment, handling, transporting, batching, curing, testing etc. all complete as per specifications, drawings and instructions of the Engineer. [Ready mix concrete will be provided by BHEL free of cost at batching plant] | cum | 110 | 440 | 0.00058873 |
| 14 | Transportation from battching plant & laying design mix cement concrete with graded aggregate (maximum size of coarse aggregate not exceeding 20 mm) for reinforced concrete work at all levels for all kinds of work, including labour, materials, equipment, handling, transporting, batching, mixing, placing, levelling, compacting, curing, testing etc. and rendering or cleaning and finishing the exposed surface with cement mortar (1:3) to give smooth and even surface, all complete as per specifications, drawings and instructions of the Engineer, but excluding all formwork and reinforcing steel. [Ready mix concrete will be provided by BHEL free of cost at batching plant) | | | | |
| i | For all works below ground level (except chimney shell) | | | | |
| b | Grade M-30 (foundations, etc) | cum | 2325 | 9300 | 0.01514490 |
| ii | For all other works | | | | |
| a | Grade M-25 grade level slab, pit, trenches,drain etc. | cum | 40 | 160 | 0.00023450 |
| c | Grade M-35 for chimney shell, corbels and external platforms and other shell attachments. | cum | 25 | 100 | 0.00031689 |
| d | Grade M-25 for all other components of the super structure, roof slab, mini -shells, beams, columns wall etc. | cum | 10 | 40 | 0.00007552 |

| VOLUME-III<br>PRICE SCHEDULE, REV-00 | | | | | |
|---|---|---|---|---|---|
| JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. | | | | | |
| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 3 - SERVICE (Part-1) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| A14 | Providing & laying design mix cement concrete with graded aggregate (maximum size of coarse aggregate not exceeding 20 mm) for reinforced concrete work at all levels for all kinds of work, including labour, materials, equipment, handling, transporting, batching, mixing, placing, levelling, compacting, curing, testing etc. and rendering or cleaning and finishing the exposed surface with cement mortar (1:3) to give smooth and even surface, all complete as per specifications, drawings and instructions of the Engineer, but excluding all formwork and reinforcing steel. [Supply of Concrete is in the scope of Contractor) | | | | |
| i | For all works below ground level (except chimney shell) | | | | |
| b | Grade M-30 (foundations, etc) | cum | 25 | 100 | 0.00122292 |
| ii | For all other works | | | | |
| a | Grade M-25 grade level slab, pit, trenches,drain etc. | cum | 10 | 40 | 0.00047052 |
| c | Grade M-35 for chimney shell, corbels and external platforms and other shell attachments. | cum | 3975 | 15900 | 0.24466129 |
| d | Grade M-25 for all other components of the super structure, roof slab, mini -shells, beams, columns wall etc. | cum | 10 | 40 | 0.00056462 |
| B14 | Extra over Sl. No. A14 for controlling of temperature of fresh concrete to less than 23 degree centigrade using ice, including all related arrangements for providing, storing and mixing of ice with water, cooling of aggregates etc. All complete as per specification, drawing and instruction of engineer in charge. | cum | 1750 | 7000 | 0.01568948 |
| 15 | Providing and applying three coats of bitumen grade 85/25 as per IS 702 ( @ 1.7kg/sqm) with 1% antistripping compound conforming to IS 6241 in foundation, shell, pedestal etc on concrete surfaces exposed to soil / ash including surface preparation etc. all complete. | Sqm | 900 | 3600 | 0.00184386 |
| 16 | Providing and placing steel reinforcements of TMT steel of grade Fe-500 /Fe 500D confirming to IS:1786 and having minimum elongation 14.5% , for reinforced concrete work, at all levels, for all kinds of work, including transportation, cleaning, derusting, straightening, cutting, bending, binding in position with annealed wire and/or welding, providing concrete cover blocks, pins, separators, chairs, supports for reinforcement, etc. with all materials, labour, equipment, handling, testing, transportation to & from stores etc., preparation of bar bending schedules, all complete as per specifications, drawings and instructions of the Engineer. | | | | |
| i | For all works below ground level (except chimney shell) | | | | |
| a | High strength deformed bars [Reinforcement bars will be issued by BHEL Free of cost] | Mt | 256 | 1023 | 0.01456424 |
| ii | For all other works | | | | |
| a | Mild steel reinforcement bars [Mild steel reinforcement procurement in vendors scope] | Mt | 10 | 40 | 0.00577282 |
| b | High strength deformed bars [Reinforcement bars will be issued by BHEL Free of cost] | Mt | 3 | 11 | 0.00017227 |
| A17 | Providing and fixing formwork of approved quality for cast-in-situ, plain or reinforced concrete works of any type and section for all works below ground level (except chimney shell) for all depths, including labour, materials, equipment, waste of forms, shoring, strutting, scaffolding, staging, tieing, nailing, caulking, bolting etc. and removal of form work and staging etc. all complete as per specifications, drawings and instructions of the Engineer. | Sqm | 800 | 3200 | 0.00258820 |
| B17 | Inner and outer faces of wind shield with slip form shuttering:<br>Providing and fixing formwork using slipform (inner and outer faces) for concreting in chimney for cast in situ, reinforced concrete works of any type and section for all elevations, including labour, materials, equipment, waste of forms, scaffolding, staging, tieing, nailing, caulking, bolting, mantainence, dismantling etc. all complete as per specifications, drawings and instructions of Engineer in charge. (Area of inner face and outer face shall be measured seperately.)<br>**Mode of Measurement:- Total formwork quantity in chimney shell applicable to Slipform work as per specifications & drawings shall be jointly measured and certified. Certified quantity(SQM) to be paid in line to the unit rate of B17a) i), B17a) ii) & B17a) iii).**<br>**(The slipform arrangement material shall be the property of contractor)** | | | | |
| a | Design, Engineering, Approval of Drawings, Supply & Installation of Slipform system as per approved drawings duly reviewed & vetted by approved Third Party/Engineering for chimney or silo or any other shell/structure work at site including all safety requirements/arrangements, installation of all supporting items like structural members, winch arrangement, wooden platforms, jacks(including testing by Third Party) & jack-rods, lighting arrangements, panels, passenger cage, nuts/bolts, manpower, all other arrangements necessary for concreting & material shifting, providing spares for smooth operation, dismantling, etc all complete.<br>**Quantity measured for B17a) i), B17a) ii) & B17a) iii) shall be same and shall be restricted to the quantity measured in B17 a iii)** | | | | |
| i) | For Mobilisation & Installation(Payment of the total certified quantity of the shell shall be made for mobilisation of slipform only after start of successful slipping as certified by Engineer in charge.) | Sqm | 15000 | 60000 | 0.04705035 |
| ii) | For Dismantling of the Slipform System(Payment of the total certified quantity of the shell shall be made only after complete dismantling of slipform as certified by Engineer in charge.) | Sqm | 15000 | 60000 | 0.01176259 |
| iii) | Slipping/Providing formwork at inner and outer faces of wind shield with slip form shuttering with slipform arrangement.<br>(Cost for design, mobilisation, installation & dismantling of slipform shall be paid seperately in Item No B17 i) & B17 ii) and cost for slipping/providing & mantainence of slipform work to be paid in this item)<br>Measurement for payment to be done progressively as per actual slipping executed at site. | Sqm | 15000 | 60000 | 0.05881294 |

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|---|---|---|---|---|---|
| JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. | | | | | |
| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 3 - SERVICE (Part-1) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| C17 | Providing and fixing formwork of approved quality for cast-in-situ, plain or reinforced concrete works of any type and section for all other components of the superstructure like slabs, beams, columns, walls, enclosures, mini shells, external platforms, corbels, other shell attachments, chases/recesses in shell etc. including labour, materials, equipment, waste of forms, all complete as per specifications, drawings and instructions of the Engineer. | Sqm | 400 | 1600 | 0.00344465 |
| 18 | Providing and fixing formwork in shell openings and pockets (above 0.1 sq.m surface area) including cutting, formation of shapes and all other operations required for making the required shape and size, removal of formwork, all complete as per specifications, drawings and instructions of the Engineer. | Sqm | 110 | 440 | 0.00094728 |
| 19 | Providing and placing in position at all levels, building paper (kraft paper), as per IS:1397, between concrete surfaces incluing the cost of labour, material, etc. complete as per drawings and instruction of the Engineer. | Sqm | 55 | 220 | 0.00001881 |
| 20 | Providing and installing, at all levels, bitumen impregnated fibre boards, 12 mm thick, conforming to IS:1838, as joint filler at joints in concrete, including nailing, coating of both faces with coal tar pitch/bitumen, including the cost of all labour, material and equipments etc., complete as per drawings, specifications and instructions of the Engineer. | Sqm | 25 | 100 | 0.00008980 |
| 21 | Providing and filling, at all levels, bitumen sealing compound (hot applied type) conforming to IS:1834, for sealing gaps and joints in concrete, including cleaning, mixing, heating, pouring or injecting, appllication of primer, cost of all labour, material and equipments etc., complete as per drawings, specifications and instructions of the Engineer. | Kg | 400 | 1600 | 0.00041947 |
| 22 | Preparing detailed fabrication drawings and after approval by the Engineer, supplying, fabricating, erecting and installing miscellaneous steel parts to be embedded/cast in concrete (like staircase embedments, corbel face plates, etc) at all positions and levels including the cost of all labour, materials and equipments for setting materials in concrete, grouting, welding, bolts & bolting, expansion anchors, drilling, cutting, etc. complete as per drawings and specification. | Mt | 3 | 12 | 0.00185758 |
| B23 | Transportation from Store(Material supplied by contractor under item no. S B23 of SCHEDULE-4), erection and alignment of shop fabricated structural steel of grade E 250 in rolled/ built up section conforming to IS:2062, mild steel rounds in columns, beams, struts, monorails, stays, safety chains, ladders, MS gratings, gantry girders, roof trusses, portals, laced purlins, space frames, hangers, wall beams, sheeting runners, brackets, stiffeners, stub columns, bracings, cleats, base plates, splice plates,gussets, end plates, steel frame grid over false ceiling, walkway platforms, ladders, stairs,stringers, treads, landings, decking and seal plates, galleries etc. with consumables, alignment, erection bolts & nuts (weight of erection bolts and nuts not payable), assembly, inspection and testing, erection scheme, protection against damage in transit, stability of structures, installation of temporary structures, setting column bases, surface preparation by means of manual or mechanical power tools as per IS:1477 part 1, rectification, dismantling and removal of all temporary structures (weight of temporary structures not payable), etc all complete. | Mt | 210 | 840 | 0.02087818 |
| C23 | Extra over ST NO. B23 for blast cleaning of steel structures to near white metal surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron and providing and applying two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT including the cost of all labour, material, equipments, protection of surface and cleaning, scoffolding, touch-up painting etc., complete as per drawings, specifications and instructions of the Engineer. Zinc dust composition and properties shall be Type-II as perASTM D520-00. Primer coat shall be applied in Shop immediately after blast cleaning by airless spray technique. | Mt (of steel) | 210 | 840 | 0.00692197 |
| D23 | Extra over ST NO. B23 for providing and applying (by airless spray technique) intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT after an interval of minimum 24 hours (from the application of primer coat) and of approved make including the cost of all labour, material, equipments, protection and cleaning, scoffolding, touch-up painting etc. all complete as per drawing and specifications. | Mt (of steel) | 210 | 840 | 0.00597129 |
| E23 | Extra over ST NO. B23 for providing and applying Finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT over steel sections already having intermediate coats, including the cost of all labour, material, equipments, protection and cleaning, scoffolding etc. all complete as per drawing and specifications. This coat shall be applied after an interval of minimum 24 hours (from the application of sealer coat) and within six (6) months (from the completion of Intermediate coat). Colour and shade of the coat shall be as approved by the Employer. | Mt(of steel) | 210 | 840 | 0.00597129 |
| A24 | Transportation from store, erection and alignment of factory made chequered plate (Material supplied by contractor under item no. S A24 of SCHEDULE-4) in platforms, staircases etc. including 1 coat of redoxide zinc-chromate primer after erection etc. all complete. (Cost on account of supply of factory made chequered plate is payable seperately under item no. S A24 of SCHEDULE-4) | Mt | 35 | 140 | 0.00211596 |
| 25 | Fixing in positing of high strength structural bolts, nuts and washers (Material supplied by contractor under item no. S25 of SCHEDULE-4 SUPPLY) for structural steel work at all level etc. complete. (Cost on account of supply of bolts, nus & washers is payable seperately under item no. S 25 of SCHEDULE-4) | Quintal | 60 | 240 | 0.00269079 |

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| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 3 - SERVICE (Part-1) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| 26 | Providing, fabricating and erecting at all levels, structural steel flues of grade E250 conforming to IS:2062 complete with all bends, flanges, stiffeners, all other flue attachments, support system, staying system, collars, access manholes and gas sampling ports alongwith gaskets,material and equipment, transporting from store, lifting to all heights, setting in place, cutting, grinding, drillings, bending, bolts and bolting, welding, preheating and post-heating for welding, testing, etc. and other required accessories, , including connection design & preparation of fabrication drgs and appointment of a seperate agency for review and approval of fabrication drgs in consultation with BHEL, all complete as per specifications and drawings. [Structural steel shall be issued by BHEL free of cost] | Mt | 255 | 1020 | 0.06638808 |
| 26 (i) | Supply & application including blast cleaning of outer surface of steel flue to near white metal surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron and providing and applying two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT including the cost of all labour, material, equipments, protection of surface and cleaning, scoffolding, touch-up painting etc., complete as per drawings, specifications and instructions of the Engineer. Zinc dust composition and properties shall be Type-II as perASTM D520-00. Primer coat shall be applied immediately after blast cleaning by airless spray technique. | SqM | 1950 | 7800 | 0.00267715 |
| 26 (ii) | Providing and applying (by airless spray technique) on outer surface of steel flue liner, an intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT after an interval of minimum 24 hours (from the application of primer coat) and of approved make including the cost of all labour, material, equipments, protection and cleaning, scoffolding, touch-up painting etc. all complete as per drawing and specifications. | SqM | 1950 | 7800 | 0.00231043 |
| 26 (iii) | Providing and applying on outer surface of steel flue liner, Finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT over steel sections already having intermediate coats, including the cost of all labour, material, equipments, protection and cleaning, scoffolding etc. all complete as per drawing and specifications. This coat shall be applied after an interval of minimum 24 hours (from the application of sealer coat) and within six (6) months (from the completion of Intermediate coat). Colour and shade of the coat shall be as approved by the Employer. | SqM | 1950 | 7800 | 0.00231043 |
| A26 | Transportation from store & installation of closed cell borosilicate glass block lining system at all elevations, on ground or in erected position, with minimum 38 mm thick borosilicate glass block, adhesive membrane having a minimum thickness of 3 mm including preparation, blast cleaning of internal surface of steel flue liner to near white metal surface finish conforming to Sa 2 ½ finish as per ISO 8501-1 and application of suitable primer, in supervision and as directed by and satisfaction of borosilicate glass block manufacturer, testing etc all complete as per specification, drawings and as directed by the glass block manufacturer & Engineer-in-charge including cost of skilled labour, material, tools & tackles, equipments, working platform etc all complete. Installation of borosilicate lining shall be done under controlled temperature and humidity conditions, as mentioned in specification, including providing all equipments required to create controlled temperature & humidity conditions inside chimney during installation, hot air blow cleaning of internal surface before application etc. all complete. [borosilicate glass blocks, adhesive membrane with mixing machine, primer paint will be issued free of cost by BHEL] | SqM | 1950 | 7800 | 0.07094449 |
| 26F | Fabricating and erecting C276 strips, plates, gutters/vanes/pipes, bends, fittings and any other appurtenances (Material supplied by contractor under item no. S 26F of SCHEDULE-4 SUPPLY) as required at all elevation in chimney for collection and withdrawal of condensate from inside of flue liner to outside based on the approved design in line with gas-flow-model study report, sealing, testing including surface preparation, TIG or any other type of specialised welding for C276 Strips etc all complete as per specification, drawing and as directed by the Engineer-in-charge. Measurement for payment shall be done for net weight of C276 strip only(weld thickness not to be considered). (Cost on account of supply of material is payable seperately under item no. S 26F of SCHEDULE-4) | Kg | 1400 | 5600 | 0.00718338 |
| 27 | Providing, fabricating and installing at various locations and elevations of the chimney system the following miscellaneous mild steel items complete with the cost of all labour, material and equipment, transporting, lifting, setting in place, cutting, grinding, drilling, welding, bolts and bolting, anchor fasteners and anchoring, priming, painting, grouting etc. complete as per drawings and specifications: | | | | |
| a | Mild steel ladders with cage, hood access hatch, louvers, bird screens, hood drain basin covers and other miscellaneous mild steel items not specifically mentioned. | Mt | 9 | 36 | 0.00629288 |
| b | 32/40 mm nominal bore medium class tubular hand railing for stair case and internal and external platforms. | Mt | 13 | 52 | 0.00949373 |
| c | Providing minimum 275 gsm Hot dipped galvanisation on mild steel parts as per specification. | Mt | 5 | 20 | 0.00140945 |
| d | Providing minimum 610 gsm Hot dipped galvanisation on mild steel parts as per specification. | Mt | 17 | 68 | 0.00814662 |
| 29A | Supplying, fabricating and installing gas sampling and gas oapacity measurement ports made of C276 pipe in chimney liners, including bolts, non metallic gaskets, cover plates and any other accessories as required, painting etc, all complete as per specification, drawing and as directed by the engineer-in-charge. | kg | 100 | 400 | 0.00148416 |

| VOLUME-III<br>PRICE SCHEDULE, REV-00 | | | | | |
|---|---|---|---|---|---|
| JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. | | | | | |
| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 3 - SERVICE (Part-1) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| 30AA | Trannsportation from store, fabricating and erecting titanium sheet (Material supplied by contractor under item no. S 30AA of SCHEDULE-4 SUPPLY) wrapped over insulation of chimney liner above roof level, including nuts, bolts, washers, screws and any other accessories as required for proper fixing, surface finishing, testing, preparation of detailed fabrication drawings etc all complete per specification, drawing and as directed by the Engineer-in-charge. (Cost on account of supply of material is payable seperately under item no. S 30AA of SCHEDULE-4) | kg | 1200 | 4800 | 0.00402831 |
| 31 | Preparing detailed fabrication drawings and after approval by the Engineer, providing, fabricating and installing at all levels, stainless plates (including stainless steel screws and fasteners) of grade AISI 316Land lead sheets beams and over the mild steel in the platform beam bearing, flue supports bearings, flue restraints brackets/ buffers etc. including the cost of all labour material & equipment, transporting, lifting to all heights, setting in place, cutting, grinding, drilling, welding of stainless steel using compatible & approved stainless steel electrodes, testing & machining flat and polishing the contact surfaces of stainless steel, coating the polished surfaces with silicone grease, etc., complete as per drawings and specifications. | | | | |
| a | Stainless steel components. | kg | 120 | 480 | 0.00046898 |
| b | Lead Sheets. | Kg | 40 | 160 | 0.00024065 |
| A32 | Design, supply, fabrication and installation of expansion compensator joints, comprising of non-metallic material (elastomeric) suitable for wet stack operations and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as per specification and shall also prevent dust accumulation, including nuts, bolts, washers, screws and any other accessories as required, preparation of detailed fabrication drawings etc all complete as per specification, drawing and as directed by the Engineer-in-charge. Design of expansion joint shall comply EPRI guideline to avoid contact of condensate with expansion joint material and to ensure drainage of condensate and the same shall be approved by BHEL/NTPC. | Sqm | 20 | 80 | 0.00410168 |
| 37 | Supplying, and placing in position (at the beam supports bearings) Neoperne pads between concrete surface and mild steel including the cost of all labour materials, cutting to shape, grinding, drilling etc., complete as per drawings and specifications. | Cum | 0.5 | 2.0 | 0.00236022 |
| 43 | Providing, and fixing asbestos ropes at expansion joints at all elevation for packing/sealing etc all complete as per specification, drawing and as directed by the Engineer-in-charge for the following. | | | | |
| b | 12 mm diameter | Rm | 205 | 820 | 0.00022428 |
| 47 | Supply and installation of resin bonded rock wool insulation having a density of not less than than 100 kg/cu.m with an installed thickness of not less than 100 mm in two layers of each 50 mm thick including plated or galvanised accessories such as pins/studs/anchors/wire netting, speed washers, tying wires, etc, on the outer surface of steel flue liners/on the inside surface of concrete windshield/ inside surface of concrete minishells/ under the cast iron caps and wherever as required at all elevation, testing etc all complete as per specification, drawing and as directed by the Engineer-in-charge. | Sqm | 200 | 800 | 0.00196060 |
| 49 | Supply and packing/sealing of rock wool insulation with loose rock wool having a density not less than 100 kg/cu.m between the insulated minishells at expansion joints/ between the lining segments and wherever as required at all levels including filling, ramming, testing, etc. all complete as per specification, drawing and as directed by the Engineer-in-charge. | Cum | 5 | 20 | 0.00037466 |
| 50 | Providing and painting with acid and heat resisting black bituminous paint conforming to type I(i) of IS:158 in not less than 4 coats having a DFT of not less than 150 microns over inside surface of chimney shell/inside and outside surfaces of minishells/underside of roof slab/ other concrete components/surfaces of the existing chimney and wherever as required etc at all elevation including surface preparation, primer etc so as to give a good finish all complete as per specification, drawing and as directed by the Engineer-in-charge. | Sqm | 100 | 400 | 0.00016889 |
| 56 | Providing and painting, at all levels, the external surfaces of chimney shell and wherever as directed by the Engineer, with acid and heat resistant polyurethane paint in alternate bands of colours 'signal red' and 'pure/bright white including the cost of all labours, material and & equipment surface preparation, primer and finish painting, protecting, cleaning etc. complete as per drawings and specification. | Sqm | 100 | 400 | 0.00030261 |
| 57 | Providing and painting, with epoxy phenolic coating system in three coats having 220 microns DFT over the external surfaces of chimney shell and wherever as required at all elevation in alternate bands of 'signal red' and 'bright white' colours including surface preparation, primer etc so as to give a good finish all complete as per drawing and specification. The coating system shall be as follows. All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free. Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Engineer-in charge. | Sqm | 7500 | 30000 | 0.01767535 |

| VOLUME-III<br>PRICE SCHEDULE, REV-00 | | | | | |
|---|---|---|---|---|---|
| JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. | | | | | |
| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 3 - SERVICE (Part-1) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| 58 | Providing and painting, with epoxy phenolic coating system in three coats having 220 microns DFT over the inside surface of chimney shell above roof/ horizontal surface of shell at top/underside of concrete roof slab and wherever as required at all elevation including surface preparation, primer etc so as to give a good finish all complete as per drawing and specification. The coating system shall be as follows. All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free. Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Engineer-in charge. | Sqm | 250 | 1000 | 0.00042223 |
| 59 | Proving and laying over the chimney roof, a composite acid and heat protection treatment including providing of slopes for roof drainage including the cost of all labour, material and equipment, etc., complete as required for preparing the roof concrete, laying under bed of plain cement concrete screed to slopes, preparation of screed surface for painting, painting the screed surface with black bituminous paint, applying bitumenmastic in layers, laying acid resisting(A/R) mortar bed and laying 75 mm thick acid resisting(A/R) bricks with A/R mortar, curing, pointing(with phenolic based A/R cement), protection and cleaning, finishing, etc., complete as per drawing and specifications. | Sqm | 140 | 560 | 0.00351635 |
| 60 | Providing, fitting& fixing, outlet and overflow, cast iron roof drain heads (with gratings) in chimney roof including sockets, adapters, brackets, hangers, supports, etc., casting-in and jointing to 150 mm nominal bore rainwater pipes, grouting, etc. including the cost of all labour material and equipement, transporting, lifting, setting in place, painting, etc. complete as per drawing and specifications. | Each | 8 | 32 | 0.00063693 |
| 61 | Providing, fitting and fixing rainwater pipes at all levels internally from the chimney roof to ground level upto the hood drain basin including shoes, bends, junctions, flanges,hoppers, sockets, adaptors, brackets, hangers, supports, anchor fasteners, spacers, pipe sleeve through shell, silicon or vulcanised butyl seaant, foam backing material, jointing, socketing, grouting, caulking, primer and finish painting etc. complete including the cost of all labour, material and equipment, complete as per drawing and specifications: | | | | |
| a | 150 mm nominal bore cast iron pipes. | Rm | 32 | 128 | 0.00053045 |
| b | 150 mm nominal bore medium class galvanised mild steel pipes. | Rm | 300 | 1200 | 0.00546408 |
| 62 | Providing and laying 50 mm thick cement concrete flooring (comprising of 12 mm thick mettallic concrete hardener topping over 38 mm thick under bed of concrete) over the grade level slab inside the chimney, including the cost of all labour, material and equipment, etc. complete as required for preparation of base, laying underbed and topping, finishing, rounding of edges, corners and junctions, curing, testing, etc. complete as per drawing and specifications. | Sqm | 380 | 1520 | 0.00142686 |
| 63 | Providing and installing an electrically operated semi grill type steel roll-up door (with the bottom one third of the curtain in solid type) at chimney base, in opening of approx size of 85 square m, with all hardware and mechanisms, fittings and fixtures, locking arrangements, frames, fasteners, gear handle arrangement for standby manual operation, all electrical accessories such as motors, control systems, cables, etc. including the cost of all labour, material and equipment, fixing in position, grouting primer and finish painting, testing, etc., complete as per drawing and specifications. | Each | 1 | 4 | 0.00192552 |
| 64 | Providing and installing at any level and location, mild steel, double plate, personnel access doors, in shell openings of size 1.1m by 2.15m, complete with all fittings and fixtures, locking arrangements, frames, fasteners including the cost all labour, material and equipment, lifting to all heights, setting in place, grouting primer and finish painting, etc., complete as per drawing and specifications. | Each | 1 | 4 | 0.00014582 |
| 67 | Supplying, fabricating and installing mild steel hatches at various locations in the chimney system complete with locking arrangements, frames, insulation, fittings and fixtures and all mechanisms and accessories reqd. for proper operation including all labour, painting etc. complete as per drawings and specifications. | | | | |
| a | Hood Access Hatch | Each | 1 | 4 | 0.00022669 |
| 68 | Conducting load testing on girders for 1.25 times the full load, on ground , including provision of test bed and jacks, dial gauges and other supplies complete as per specification and drawings and approval of engineer in-charge. | Pair | 1 | 4 | 0.00156335 |
| 70 | Providing & grouting of pocket holes, pipe sleeves and under base plates of structural steel work/ machinery/ pipe supporting structures including roughening of surface, cleaning, ramming, curing etc. all complete with Conbextra GP-1 or equivalent. (Cost of all material and cleaning of the pockets by compressed air shall be in the scope of the contractor). | Cum | 0.5 | 2.0 | 0.00017686 |
| 71 | Providing & grouting of pocket holes, pipe sleeves and under base plate of structural steel work/ machinery/ pipe supporting structures including roughening of surface, cleaning, ramming, curing etc. all complete with mix 1:1:2 (1 cement : 1 coarse sand : 2 aggregate of 6 mm down graded stonechips ) using non shrink admixture. (Cost of all material and cleaning the pocket by compressed air shall be in the scope of the contractor). | CUM | 0.5 | 2.0 | 0.00006523 |

| VOLUME-III<br>PRICE SCHEDULE, REV-00 | | | | | |
|---|---|---|---|---|---|
| JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. | | | | | |
| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 3 - SERVICE (Part-1) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| 72 | Erection of Elevator (supplied by contractor under item no. S 72 of SCHEDULE-4 SUPPLY) from ground upto top of chimney with landing at various platform level complete as per spec. and drawings.(Cost on account of supply of Elevator is payable seperately under item no. S 72 of SCHEDULE-4) | Lumpsum | 1 | 4 | 0.01302293 |
| 73 | Supplying, fabricating and erecting FRP Pipes with all bends, flanges, stiffeners, all other flue attachments, including support system, collars, connection with C276 pipes and any other accessories as required outside chimney flue liner at all elevation based on the approved design in line with gas-flow-model study report, including surface finishing, sealing, lamination, moulding, testing, guarantee/warranty etc. complete as per drawings, specification, manufacturer's recommendations and relevant codes. | Kg | 450 | 1800 | 0.00126111 |
| **Part-1B** | **ELECTRICAL WORKS** | | | | |
| | Installation, testing & commissioning of following items as per specification) (Material as per Sl No. SE1 to SE29 of SCH-4 SUPPLY) | | | | |
| E1 | 415V, 200A, 50 KA for 1 sec, 4 wire AC Distribution Board with 1No. incomer (SFU) , 12 nos. of 100A SFU (TPN) outgoing alongwith 100KVA lighting transformer (415/433) V in Incomer, Dyn11, Z=4%, ±2x2.5% off ckt. Tap) complete in all respects | no. | 1 | 4 | 0.00121828 |
| E2 | 415V, 200A, 4 wire AC Emergency Lighting distribution board alongwith 50KVA lighting transformer (415/433 V, Dyn11, Z=4%, ±2x2.5% off ckt. Tap) with 2 nos. of SFU (TPN) incomers with auto changeover facility using contactors and 8 nos. 100A SFU (TPN) outgoings complete in all respects. In case load requirement of chimney can not be met by 50 kVA lighting transformer after considering loading, 100 kVA lighting transformer shall be provided alongwith suitably rated components without any commercial implications to the purchaser. | no. | 1 | 4 | 0.00154311 |
| E3 | Normal AC lighting panel outdoor type with degree of protection IP 55 with one no. 100A SFU (TPN) Incomer , 20 outgoing (16A SP MCBs) | no. | 2 | 8 | 0.00044353 |
| E4 | Emergency lighting panel outdoor type with degree of protection IP 55 with One no. of 100A SFU(TPN) incomer and 12 outgoings (16A, SP MCBs) | no. | 2 | 8 | 0.00038501 |
| E5 | Aviation lighting panel outdoor type with degree of protection IP 55 with one no. 100A SFU (TPN) Incomer , 8 outgoing 32A SFU (TPN), photodetector and timer circuit along with 100A contactor to control aviation lighting system. | no. | 1 | 4 | 0.00027212 |
| E6 | Aviation obstruction lights (mounted on door panel openable from interior) : | | | | |
| a. | High intensity flashing light Type-A (LED type ) as per<br>ICAO standard having intensity of 20,0000 candles depending upon background illuminance & flashing frequency 20-60/min with all accessories, photocell, timer etc. | no. | 12 | 48 | 0.00803892 |
| E7 | Aviation Distribution Board (ADB) with one 32A SFU (TPN) incomer and 8 nos. SP 20A MCB. Construction is same as Lighting Panel. | no. | 1 | 4 | 0.00010283 |
| E8 | Flood light type 120W(approx) LED/HPSV luminaire with fitting (integrated /retrofitted LED/HPSV lamp ) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W. | no. | 6 | 24 | 0.00039144 |
| E9 | Well glass type 30W(approx) LED/HPSV luminaire with fitting (integrated /retrofitted LED/HPSV lamp ) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W. | no. | 64 | 256 | 0.00110904 |
| E10 | Well glass type 70W(approx) LED/HPSV luminaire with fitting (integrated /retrofitted LED/HPSV lamp ) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W. | no. | 35 | 140 | 0.00009512 |
| E11 | Well glass type 50W(approx) LED/HPSV luminaire with fitting (integrated /retrofitted LED/HPSV lamp ) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W. | no. | 20 | 80 | 0.00004348 |
| E12 | 63Amp welding switch socket with plug & other Mounting accessories | no. | 3 | 12 | 0.00009093 |
| E13 | 3 pin, 1 ph, 240V, 20Amp. Industrial Power sockets complete with plug Switches etc. | no. | 3 | 12 | 0.00003019 |
| E14 | Al conductor, HR PVC insulated, Armoured, PVC inner sheath,PVC outer sheath, FRLS type 1100V grade conforming to IS-1554 Part I. | | | | |
| a | 3½ C x95mm2 Al for connection between ACDB/ELDB/ welding sockets | Mtrs. | 1500 | 6000 | 0.00251566 |
| b | 3½ Cx35mm2 Al for Lighting panel incoming supply | Mtrs. | 1000 | 4000 | 0.00085971 |
| c | 4C x16mm2 Al for connection between ALP/ADB/Aviation Lights | Mtrs. | 250 | 1000 | 0.00027340 |
| b | 4C x 2.5mm2 Cu Control cable for Aviation lighting system | Mtrs. | 500 | 2000 | 0.00016581 |
| E15 | Cu conductor, HR-PVC insulated, PVC inner sheath,PVC outer sheathed and FRLS type 1100V grade conforming to IS-1554 Part I. | | | | |
| a | 2.5 mm2 | Mtrs. | 2000 | 8000 | 0.00027716 |
| b | 4.0 mm2 | Mtrs. | 5000 | 20000 | 0.00089230 |
| E16 | GI pipe conduit with minimum 25 mm dia with GI junction boxes, GI pull boxes (Size 200x200x100mm of 16 SWG sheet steel for junction & pull boxes) & accessories etc. complete in all respects. | Mtrs. | 2000 | 8000 | 0.00168829 |
| E17 | PVC coated Flexible steel conduit 25mm<br>dia with accessories | Mtrs. | 100 | 400 | 0.00001493 |
| E18 | Lightning protection Air terminal : Lead coated copper material of 20 mm dia & 3 metre long. | no. | 6 | 24 | 0.00021890 |

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|---|---|---|---|---|---|
| JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. | | | | | |
| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 3 - SERVICE (Part-1) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| E19 | 50x6 Lead Coated GI Strip for coronal band on flue and top platform | Mtrs. | 150 | 600 | 0.00013946 |
| E20 | Electrical equipment earthing materials including down conductors 50x6 GI Strip | Mtrs. | 700 | 2800 | 0.00057422 |
| E21 | Electrical equipment earthing materials including down conductors 25x3 GI Strip | Mtrs. | 700 | 2800 | 0.00019129 |
| E22 | 8 SWG GI wire for equipment earthing | Mtrs. | 2000 | 8000 | 0.00013149 |
| E23 | Test links for 50x6 down conductors enclosed in 200mm X 200mm X 100mm GI box of 16SWG sheet steel. | no. | 4 | 16 | 0.00007291 |
| E24 | 40mm dia MS rod for earthing of down conductor | Mtrs. | 200 | 800 | 0.00121532 |
| E25 | Earthpit with earthing electrode including brick chamber with cover, accessories etc. complete in all respect. | no. | 6 | 24 | 0.00016724 |
| E26 | Telephone socket with junction box etc. complete | no. | 6 | 24 | 0.00005610 |
| E27 | Telephone handsets complete | no. | 6 | 24 | 0.00005417 |
| E28 | Telephone cable of minimum 0.6 mm dia annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, tip corded, PVC sheathed, confirming to relevant ITD (Indian Telephones department) specification | | | | |
| a | 24 pairs | Mtrs. | 300 | 1200 | 0.00019416 |
| b | 2 pairs | Mtrs. | 100 | 400 | 0.00001551 |
| E29 | GS cable trays. Cable trays shall be of ladder type constructed of minimum 2 mm thick mild steel hot dip galvanise including cover, cabling material, accessories etc. | | | | |
| a | 150 mm wide | Mtrs. | 400 | 1600 | 0.00199281 |
| | **TOTAL** | | | | **0.76198279** |

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**JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.**

**TENDER NO. PSER:SCT:NBN-C2067:20**

**SCHEDULE- 4 - SUPPLY (Part-2)**

| SL No. | Description | Unit | Quantity (1 Chimney) | Quantity (4 Chimneys) | Weightage |
|---|---|---|---|---|---|
| | **CIVIL WORKS** | | | | |
| S B23 | Supply and fabrication (shop fabricated in customer approved shop as per specification) of structural steel of grade E 250 in rolled/ built up section conforming to IS:2062, mild steel rounds in columns, beams, struts, monorails, stays, safety chains, ladders, MS gratings, gantry girders, roof trusses, portals, laced purlins, space frames, hangers, wall beams, sheeting runners, brackets, stiffeners, stub columns, bracings, cleats, base plates, splice plates,gussets, end plates, steel frame grid over false ceiling, walkway platforms, ladders, stairs,stringers, treads, landings, decking and seal plates, galleries etc including blast cleaning, providing & applying primer,providing and applying intermediate, final and final finish coat of paint (blast cleaning,primer and paint shall be paid separately as per item no C23, D23 & E23 of SCHEDULE-3), connection design, preparation of fabrication drgs and appointment of a seperate agency for review and approval of fabrication drgs in consultation with BHEL, straightening, cutting, bending, rolling, grinding, machining, drilling, welding, electrodes and other consumables, assembly, edge preparation, preheating / post heating if required, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, protection against damage in transit etc all complete. (Final measurement of total qty of this item shall be shall be restricted to total quantity of Item no. B23 of SCHEDULE-3 admitted in final bill). | MT | 210 | 840 | 0.10227863 |
| S A24 | Supplying factory made chequered plate with mild steel conforming to IS:2062 in platforms, staircases with edge binding strips and anti-skid nosing in treads etc. including 1 coat of redoxide zinc-chromate primer, fixing clamps, fittings, fixtures, all taxes, duties, packing, grinding, drilling, welding, edge preparation, etc. all complete. (Final measurement of total qty of this item shall be shall be restricted to total quantity of Item no. A24 of SCHEDULE-3 admitted in final bill). | Mt | 35 | 140 | 0.01401972 |
| S 25 | Supplying of high strength structural bolts up to and inclusive of 39 mm diameter and upto 1500 mm long (of property class 8.8 and product grade `C' as per IS: 1367) and conforming to IS: 3757 and high strength structural hardened and tempered nuts (of property class `8' as per IS:1367) conforming to IS:6623 with hardened and tempered washers as per IS:6649 etc. for structural steel work etc all complete. (Final measurement of total qty of this item shall be shall be restricted to total quantity of Item no. 25 of SCHEDULE-3 admitted in final bill). | Quintal | 60 | 240 | 0.00627852 |
| S 26F | Supplying C276 strips, plates, gutters/vanes/pipes, bends, fittings and any other appurtenances as required at all elevation in chimney for collection and withdrawal of condensate from inside of flue liner to outside based on the approved design in line with gas-flow-model study report all complete as per specification, drawing and as directed by the Engineer-in-charge. (Final measurement of total qty of this item shall be shall be restricted to total quantity of Item no. 26F of SCHEDULE-3 admitted in final bill). | Kg | 1400 | 5600 | 0.01676121 |
| S 30AA | Supplying titanium sheet (Grade 2 as per ASME B265) to be wrapped over insulation of chimney liner above roof level as per specification, drawing and as directed by the Engineer-in-charge. (Final measurement of total qty of this item shall be shall be restricted to total quantity of Item no. 30AA of SCHEDULE-3 admitted in final bill). | kg | 1200 | 4800 | 0.00939938 |
| S 33 | Supply of fabricated ready to install expansion compensator in line with item no A32 of SCHEDULE-3 as spare including nuts, bolts, washers, screws and any other accessories as required for successful installation. | Sqm | 10 | 40 | 0.00149050 |
| S 72 | Design, engineering annd supply after approval by Engineer a rack and pinion type Elevator of min 400 kg load carrying capacity for erection as per item no. 72 of SCHEDULE-3, from ground upto top of chimney with landing at various platform level, including all fixtures and accessories complete as per spec. and drawings. | Lumpsum | 1 | 4 | 0.03038684 |
| | **ELECTRICAL WORKS** | | | | |
| | Design, Engineering, Supply including testing of following items as per specification | | | | |
| S E1 | 415V, 200A, 50 KA for 1 sec, 4 wire AC Distribution Board with 1No. incomer (SFU) , 12 nos. of 100A SFU (TPN) outgoing alongwith 100KVA lighting transformer (415/433) V in Incomer, Dyn11, Z=4%, ±2x2.5% off ckt. Tap) complete in all respects | no. | 1 | 4 | 0.00284265 |
| S E2 | 415V, 200A, 4 wire AC Emergency Lighting distribution board alongwith 50KVA lighting transformer (415/433 V, Dyn11, Z=4%, ±2x2.5% off ckt. Tap) with 2 nos. of SFU (TPN) incomers with auto changeover facility using contactors and 8 nos. 100A SFU (TPN) outgoings complete in all respects. In case load requirement of chimney can not be met by 50 kVA lighting transformer after considering loading, 100 kVA lighting transformer shall be provided alongwith suitably rated components without any commercial implications to the purchaser.. | no. | 1 | 4 | 0.00360058 |
| S E3 | Normal AC lighting panel outdoor type with degree of protection IP 55 with one no. 100A SFU (TPN) Incomer , 20 outgoing (16A SP MCBs) | no. | 2 | 8 | 0.00103489 |
| S E4 | Emergency lighting panel outdoor type with degree of protection IP 55 with One no. of 100A SFU(TPN) incomer and 12 outgoings (16A, SP MCBs) | no. | 2 | 8 | 0.00089836 |

**VOLUME-III**
**PRICE SCHEDULE, REV-00**

**JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR.**

**TENDER NO. PSER:SCT:NBN-C2067:20**

**SCHEDULE- 4 - SUPPLY (Part-2)**

| SL No. | Description | Unit | Quantity (1 Chimney) | Quantity (4 Chimneys) | Weightage |
|---|---|---|---|---|---|
| S E5 | Aviation lighting panel outdoor type with degree of protection IP 55 with one no. 100A SFU (TPN) Incomer , 8 outgoing 32A SFU (TPN), photodetector and timer circuit along with 100A contactor to control aviation lighting system. | no. | 1 | 4 | 0.00063495 |
| S E6 | Aviation obstruction lights (mounted on door panel openable from interior) : | | | | |
| a | High intensity flashing light Type-A (LED type )as per ICAO standard having intensity of 20,0000 candles depending upon background illuminance & flashing frequency 20-60/min with all accessories, photocell, timer etc. | no. | 12 | 48 | 0.01875749 |
| S E7 | Aviation Distribution Board (ADB) with one 32A SFU (TPN) incomer and 8 nos. SP 20A MCB. Construction is same as Lighting Panel. | no. | 1 | 4 | 0.00023994 |
| S E8 | Flood light type 120W(approx) LED/HPSV luminaire with fitting (integrated /retrofitted LED/HPSV lamp ) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W. | no. | 6 | 24 | 0.00091336 |
| S E9 | Well glass type 30W(approx) LED/HPSV luminaire with fitting (integrated /retrofitted LED/HPSV lamp ) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W. | no. | 64 | 256 | 0.00258776 |
| S E10 | Well glass type 70W(approx) LED/HPSV luminaire with fitting (integrated /retrofitted LED/HPSV lamp ) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W. | no. | 35 | 140 | 0.00022195 |
| S E11 | Well glass type 50W(approx) LED/HPSV luminaire with fitting (integrated /retrofitted LED/HPSV lamp ) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W. | no. | 20 | 80 | 0.00010146 |
| S E12 | 63Amp welding switch socket with plug & other Mounting accessories | no. | 3 | 12 | 0.00021217 |
| S E13 | 3 pin, 1 ph, 240V, 20Amp. Industrial Power sockets complete with plug Switches etc. | no. | 3 | 12 | 0.00007044 |
| S E14 | Al conductor, HR PVC insulated, Armoured, PVC inner sheath,PVC outer sheath, FRLS type 1100V grade conforming to IS-1554 Part I. | | | | |
| a | 3½ C x95mm2 Al for connection between ACDB/ELDB/ welding sockets | Mtrs. | 1500 | 6000 | 0.00586987 |
| b | 3½ Cx35mm2 Al for Lighting panel incoming supply | Mtrs. | 1000 | 4000 | 0.00200600 |
| c | 4C x16mm2 Al for connection between ALP/ADB/Aviation Lights | Mtrs. | 250 | 1000 | 0.00063792 |
| b | 4C x 2.5mm2 Cu Control cable for Aviation lighting system | Mtrs. | 500 | 2000 | 0.00038689 |
| S E15 | Cu conductor, HR-PVC insulated, PVC inner sheath,PVC outer sheathed and FRLS type 1100V grade conforming to IS-1554 Part I. | | | | |
| a | 2.5 mm2 | Mtrs. | 2000 | 8000 | 0.00064670 |
| b | 4.0 mm2 | Mtrs. | 5000 | 20000 | 0.00208204 |
| S E16 | GI pipe conduit with minimum 25 mm dia with GI junction boxes, GI pull boxes (Size 200x200x100mm of 16 SWG sheet steel for junction & pull boxes) & accessories etc. complete in all respects. | Mtrs. | 2000 | 8000 | 0.00393933 |
| S E17 | PVC coated Flexible steel conduit 25mm dia with accessories | Mtrs. | 100 | 400 | 0.00003483 |
| S E18 | Lightning protection Air terminal : Lead coated copper material of 20 mm dia & 3 metre long. | no. | 6 | 24 | 0.00051077 |
| S E19 | 50x6 Lead Coated GI Strip for coronal band on flue and top platform | Mtrs. | 150 | 600 | 0.00032540 |
| S E20 | Electrical equipment earthing materials including down conductors 50x6 GI Strip | Mtrs. | 700 | 2800 | 0.00133985 |
| S E21 | Electrical equipment earthing materials including down conductors 25x3 GI Strip | Mtrs. | 700 | 2800 | 0.00044634 |
| S E22 | 8 SWG GI wire for equipment earthing | Mtrs. | 2000 | 8000 | 0.00030681 |
| S E23 | Test links for 50x6 down conductors enclosed in 200mm X 200mm X 100mm GI box of 16SWG sheet steel. | no. | 4 | 16 | 0.00017012 |
| S E24 | 40mm dia MS rod for earthing of down conductor | Mtrs. | 200 | 800 | 0.00079688 |
| S E25 | Earthpit with earthing electrode including brick chamber with cover, accessories etc. complete in all respect. | no. | 6 | 24 | 0.00039023 |
| S E26 | Telephone socket with junction box etc. complete | no. | 6 | 24 | 0.00013091 |

| VOLUME-III<br>PRICE SCHEDULE, REV-00 | | | | | |
|---|---|---|---|---|---|
| JOB: CONSTRUCTION OF 4 NOS 150 M TALL SINGLE FLUE RCC CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN (EXCLUDING PILE) AT 4X250 MW BRBCL NABINAGAR TPP FGD, BIHAR. | | | | | |
| TENDER NO. PSER:SCT:NBN-C2067:20 | | | | | |
| SCHEDULE- 4 - SUPPLY (Part-2) | | | | | |
| **SL No.** | **Description** | **Unit** | **Quantity (1 Chimney)** | **Quantity (4 Chimneys)** | **Weightage** |
| S E27 | Telephone handsets complete | no. | 6 | 24 | 0.00012639 |
| S E28 | Telephone cable of minimum 0.6 mm dia annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, tip corded, PVC sheathed, confirming to relevant ITD (Indian Telephones department) specification | | | | |
| a | 24 pairs | Mtrs. | 300 | 1200 | 0.00045305 |
| b | 2 pairs | Mtrs. | 100 | 400 | 0.00003619 |
| S E29 | GS cable trays. Cable trays shall be of ladder type constructed of minimum 2 mm thick mild steel hot dip galvanise including cover, cabling material, accessories etc. | | | | |
| a | 150 mm wide | Mtrs. | 400 | 1600 | 0.00464989 |
| | **TOTAL** | | | | **0.23801721** |